HIGH SPEED RAILROAD TECHNOLOGY

HEARING

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION,
AVIATION AND MATERIALS

OF THE

COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDREDTH CONGRESS

FIRST SESSION

APRIL 3, 1987

[No. 11]

Printed for the use of the
Committee on Science, Space, and Technology

U.S. GOVERNMENT PRINTING OFFICE
73-721 WASHINGTON : 1987

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

H701-57

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

ROBERT A. ROE, New Jersey, *Chairman*

GEORGE E. BROWN, Jr., California
JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
HAROLD L. VOLKMER, Missouri
BILL NELSON, Florida
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California
BUDDY MacKAY, Florida**
TIM VALENTINE, North Carolina
ROBERT G. TORRICELLI, New Jersey
RICK BOUCHER, Virginia
TERRY BRUCE, Illinois
RICHARD H. STALLINGS, Idaho
BART GORDON, Tennessee**
JAMES A. TRAFICANT, Jr., Ohio
JIM CHAPMAN, Texas
LEE H. HAMILTON, Indiana
HENRY J. NOWAK, New York
CARL C. PERKINS, Kentucky
TOM McMILLEN, Maryland
DAVID E. PRICE, North Carolina
DAVID R. NAGLE, Iowa
JIMMY HAYES, Louisiana
DAVID E. SKAGGS, Colorado***

MANUEL LUJAN, Jr., New Mexico*
ROBERT S. WALKER, Pennsylvania
F. JAMES SENSENBRENNER, Jr., Wisconsin
CLAUDINE SCHNEIDER, Rhode Island
SHERWOOD L. BOEHLERT, New York
TOM LEWIS, Florida
DON RITTER, Pennsylvania
SID W. MORRISON, Washington
RON PACKARD, California
ROBERT C. SMITH, New Hampshire
PAUL B. HENRY, Michigan
HARRIS W. FAWELL, Illinois
D. FRENCH SLAUGHTER, Jr., Virginia
LAMAR SMITH, Texas
ERNEST L. KONNYU, California
JACK BUECHNER, Missouri
JOEL HEFLEY, Colorado
CONSTANCE A. MORELLA, Maryland

HAROLD P. HANSON, *Executive Director*
ROBERT C. KETCHAM, *General Counsel*
REGINA A. SNYDER, *Chief Clerk*
R. THOMAS WEIMER, *Republican Staff Director*

SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS

DAVE McCURDY, Oklahoma, *Chairman*

DAN GLICKMAN, Kansas
BILL NELSON, Florida
TOM McMILLEN, Maryland
JIMMY HAYES, Louisiana

TOM LEWIS, Florida
ROBERT S. WALKER, Pennsylvania
F. JAMES SENSENBRENNER, Jr., Wisconsin

---

*Ranking Republican Member.
**Resigned February 19, 1987 (H. Res. 89).
***Elected March 30, 1987 (H. Res. 133).

CONTENTS

WITNESSES

April 3, 1987:

Page

- John Riley, Administrator, Federal Railroad Administration, Washington, DC 4
- Bill Miller, deputy assistant secretary, Florida Department of Transportation; and Charles Smith, executive director, Florida High-Speed Rail Transportation Commission 15
- Statement of Kenneth Adams, county commissioner 45
- Robert Blanchette, president, the TGV Co., Washington, DC; and Sam Tabuchi, director, JNR Mag-Lev Florida Office, Tallahassee, FL 47
- Dr. Henry Kolm, All American Magneplane, Inc., New Port Richey, FL; and Sam Tabuchi, director, JNR Mag-Lev Florida Office, Tallahassee, FL 65
- Cynthia Drew, vice president, Entrak Systems, Inc., Dallas, TX; Dr. Glenn A. Burdick, consultant, Tarpon Springs, FL, and Raul Bravo, Florida High Speed Rail Corp., Deerfield Beach, FL 111
- Jim Minix, St. Lucie County Commissioner, and Bill Palmer, former county commissioner 157

APPENDIX

1. Hearing charter 159
2. Background on Florida's high speed rail 165

HIGH SPEED RAILROAD TECHNOLOGY

FRIDAY, APRIL 3, 1987

House of Representatives, Committee on Science, Space, and Technology, Subcommittee on Transportation, Aviation and Materials,
West Palm Beach, FL.

The subcommittee met, pursuant to notice, at 9 a.m., in the Commission Chambers, Palm Beach County Courthouse, 200 Second Street, West Palm Beach, Florida, Hon. Dave McCurdy presiding.

Mr. McCurdy. Good morning. It is 9:00, this is Friday, and this is West Palm Beach, I suppose.

Mr. Lewis. That is correct.

Mr. McCurdy. It is a pleasure for us to be here today.

This morning the Subcommittee on Transportation, Aviation and Materials of the Science, Space, and Technology Committee is pleased to be convened here in West Palm Beach for a hearing on high-speed rail technology and its possible adaptation in Florida.

The Subcommittee on Transportation, Aviation and Materials has had a long-standing interest in high-speed rail technology and, in fact, issued a Committee Report in September of 1982 recommending that Congress consider the development of high-speed rail corridors as a key component of future national transportation policies.

Although the role of the Federal Government in fostering the use of high-speed rail technology has been minimal, it is clear that if the United States is ever to develop a truly balanced national transportation system, high-speed rail technology must certainly be considered as a key component.

With many major airports and interstate highways already reaching the saturation point, innovative high-speed rail systems may indeed play a key role in meeting the future transportation needs of our nation.

I welcome this opportunity to look at some of these high-speed and newer super-speed MagLev technologies and would like to thank the expert witnesses who agreed to assist us today.

I have been looking forward to this hearing for some time, not only for the fact that I think it is going to be an informative meeting, but I look forward to coming to West Palm and the District of my good friend and colleague, Mr. Lewis, who, by the way, is in my opinion one of the more knowledgeable members of our committees in Congress in these kinds of technologies, and also with his experience in the aerospace industry, he has been a major contributor in the aerospace industry in the whole issue of aviation and transportation, and it is nice to have a working engineer and professor over here who understands some of the issues that we deal with on a regular basis.

There was no hesitation when we were asked to convene this hearing here, on my part. As a matter of fact, I am going to do the unusual today, since we are in Mr. Lewis' District. I am going to turn the gavel over to Mr. Lewis and let him chair this hearing. And I look forward to hearing the witnesses and participating today.

Tom?

Mr. LEWIS [presiding]. Thank you, Mr. Chairman.

Let me take this opportunity to thank you for coming here. It is a long way from Oklahoma and we appreciate you spending your time with us, rather than going out to Oklahoma today.

I want to say the same thing to my colleague from Wisconsin, Mr. Jim Sensenbrenner. I want to welcome all of you to this important Congressional hearing on high-speed rail technology here in West Palm Beach, Florida.

As we are all well aware, our air transportation system is becoming increasingly congested, and flights of under two or three hundred miles place a relatively heavy burden on that system when related to passenger miles flown.

Even with the modernization of the National Air Space System—which many of us question at this point—planned for the early 1990s, there will still be a growing demand for alternatives to these shorter flights. A safe, economical, high-speed railroad system could play a vital role in satisfying our future transportation needs, particularly if we see a return of the oil shortages of the 1970s.

As mentioned, Magnetic Levitation, or MagLev, as it is called, appears to be an attractive technology option, promising speeds in excess of 250 miles per hour—faster than any operational system today. With these kinds of speeds, there are potentially a number of corridors, such as the West Palm Beach to Miami route, where passenger rail service might well attract sufficient ridership to justify the investment.

Although in recent years the United States has lagged far behind the rest of the world in developing high-speed technology, recent developments in science indicate that this could soon change.

In February of this year, scientists from the University of Houston achieved a breakthrough in rail technology that could well advance the industry into the 21st century.

These Houston research scientists, using new metal alloys, developed a new technique for the superconductivity of electricity at temperatures that can be achieved ten times cheaper and twenty times more effectively than is currently being done with MagLev systems.

This would enable the MagLev technology—which we will hear more about today—to be even more cost effective. Clearly this breakthrough is the most significant advancement in superconductivity in 75 years and could be a major step in the direction of the United States regaining rail technology superiority.

As many of today's witnesses will testify, other countries have a stronger commitment to high-speed technology than does the Federal Government. We in Florida want to benefit from all of these efforts.

Without a high-speed rail system in Florida, by the year 2000 the entire strip from West Palm Beach to Dade County could become one gigantic concrete roadway, if the projected increases in automobile traffic come true. But if the vision and planning of state and local officials becomes a reality, people will be able to travel the South Florida corridors in speed and comfort in a high-speed rail locomotive system.

This is the focus of today's hearing, to examine the advantages and disadvantages of the various high-speed rail technologies.

I want to welcome our witnesses, and others in attendance, who have graciously given their time to be with us this morning.

Our first panel this morning—excuse me, Mr. Sensenbrenner, do you have an opening statement?

Mr. **Sensenbrenner**. Thank you very much, Mr. Chairman.

Mr. **Lewis**. I am not used to this.

Mr. **Sensenbrenner**. It is good to see you in the chair.

I certainly appreciate the opportunity of coming to West Palm Beach this morning to talk about high-speed rail technology.

As you may know, the Chicago-Milwaukee corridor is one of those that is being examined for future high-speed rail development and I think that the real guinea pig as to whether this will be economically and technologically feasible will be South Florida, because there the population is growing, the airports and the highways are significantly overtaxed and there might be a way to wean some people in South Florida from the American love affair with the automobile and get them on a train.

Frankly I think that anything is technologically feasible if we throw enough money at it. But what I am interested in finding out is whether it will be economically feasible, as well, because in these days of Gramm-Rudman and scarce financial resources at all levels of government, we have to figure out how to stretch the taxpayers' dollar to the greatest extent possible.

I do not think anybody on this subcommittee has any problem with putting Federal money into transportation alternatives that people and business will use, but we do not want to see a repeat of formulas where we put Federal dollars to run empty trains or run empty buses or run empty airplanes.

The Shinkansen in Japan and some of the high-speed rail technologies that are being developed in Europe work because the people get on the trains and use the facilities. I think that is one of the things that we are looking for here when this subcommittee makes a determination on whether to authorize funds for additional research into this area.

So I thank Representative Lewis for his hospitality. I will say that the Palm Beach Chamber of Commerce is a little bit more accurate than that of Cape Canaveral, because I was down there with the Science Committee on Monday and I thought that the Sunshine State motto should be turned over to the Federal Trade Commission for investigation on that day, but I guess it is right.

Thank you.

Mr. **Lewis**. Thank you, Jim.

Mr. LEWIS. Our first panelist this morning will be Mr. John Riley, who is Administrator of the Federal Railroad Commission. I welcome John and, as you can see, all the world is not the same, having been in Canada yesterday with all that snow and now you are in sunny Florida.

STATEMENT OF JOHN RILEY, ADMINISTRATOR, FEDERAL RAILROAD ADMINISTRATION, WASHINGTON, DC

Mr. RILEY. I was going to say that I absolutely endorse the Sunshine State motto. We left a blizzard in Montreal in midday yesterday and this certainly looks like sunshine to me.

I also would endorse the comment that the most persuasive argument for high-speed rail is not contained in my remarks this morning. It was personified by the flight experience we had getting down here last night. I have often said to my friends in the FAA, I do not need to argue for high-speed rail, the airlines will deliver it to us, given enough time. [Laughter.]

It is a pleasure to join the committee here. You know there are some things you do because it is part of the job, there are some positions you take because they are administration positions. Then there are other things you do because you really believe in it, because it is a labor of love. And that is what this issue is for me.

I was involved with high-speed rail long before I ever came to the Federal Railroad Administration. Back a good eight years ago, I was part of a half-dozen-person team that established the initial technology exchange with Japan and with France that led to the initiation of so many of the high-speed rail projects that are going on today, and in particular the Florida project.

I have spoken about high-speed rail to audiences from Washington to Chicago, from Tokyo to Paris, and it is a special privilege to talk about it here in Florida where it is going to happen—and I think it really is going to happen in Florida.

I am absolutely convinced, and I have been for a long time, that high-speed rail is going to be a reality in our lifetime. Every major industrialized nation in this world either has a high-speed rail system or has taken the first steps toward developing one. And it is inconceivable to me that the United States will be the one nation left behind.

My conviction on this has grown deeper as more Americans have traveled overseas to see the impact that these systems have had on the quality of life of people who benefit from them in France and in Japan. It is an impact that goes beyond transportation, to impacts that are environmental, that relate to tourism and that relate to the sound development of specific corridors.

I have also become more convinced as the immensity of the financial commitment that is going to be necessary to maintain other modes of transportation becomes more obvious. We have learned in the last few days how many billions of dollars are required just to keep the highway system in the state that it is today. And I think we will learn very shortly that the complexities of expanding or developing a high-speed rail system are no greater than the economic and political complexities of expanding the airport system to meet greater capacity.

I agree with the comment that one of the speakers made a few moments ago, that environmental and energy pressures of the future are also a compelling argument for the development of high-speed rail.

A TGV with the same load factor uses approximately one-sixth the energy of a narrow-bodied jet plane. The energy consumed by a TGV at 170 to 180 miles per hour is actually less than that consumed by a metroliner at 120.

These are remarkable figures and I am not singling out a TGV. They apply to the other high-speed rail technologies, as well. But it leads me to the conclusion that this is something that is going to happen and the only issue is where, when and what role every one of us is going to play in bringing that all about.

I think when we have succeeded—and I think we will succeed—the people who are promoting high-speed rail will have made as lasting a contribution to the American transportation scene as those who promoted the steamboat, the first passenger trains and commercial aviation.

The reason it is special to talk about this in Florida is that Florida really does have an opportunity to be on the cutting edge of history because it is the flagship project.

We have eight projects going on in various parts of the country, and the future of high-speed rail in the other seven, and others not yet commenced, depends very largely on the success that Florida has in introducing this project and making it credible to the financial markets.

I think Florida will succeed, and I have to emphasize to the committee, I realize that it is protocol when you do a field hearing like this to come into the state and say this is a good project and it is going to succeed.

You can forget that. What I am saying about Florida this morning I have said in every other part of the country and in other parts of the world. Why do I think it will succeed? Several reasons—some are demographic.

The Florida corridor does have excellent demographics, both in geography and in population. It is a very straight corridor with very few hills. One of the issues you have to deal with on high-speed rail is that at very high speeds the tolerable centrifugal force on passengers decreases very, very rapidly and, in fact, on the new sections of the Shinkansen and the TGV the sharpest curve radius that specifications tolerate for 160 mile per hour operations is a radius of about four kilometers, which is very close to a straight line. Few places have the type of corridor that can accommodate that type of engineering at low cost. Florida has that kind of corridor.

In addition, the Florida climate is conducive to reasonable cost maintenance of either a conventional steel wheel, steel rail system, or a magnetic levitation system, where contamination is a very major issue.

There is also a broad recognition in this community that Florida needs to construct new transportation systems for the demands of the next decade and the next century.

But all of the advantages of Florida are not demographic. Some are personal. The bottom line is that I have watched this project from its inception, and Florida has simply done it right.

Florida's ridership study is a serious study based on essentially conservative assumptions. There is nothing more fatal to the promotion of a state of the art project than proceeding on inflated ridership numbers or over-optimistic assumptions. At least at this stage, Florida has avoided that.

Second, and I think equally important, Florida has taken the time to define the relationship between the project promoters, between the vendors of the technology and the community served. You have got enabling legislation that sets up a process, one that proceeds at a reasonable pace, but does not attempt to push a new concept on people before they have an opportunity to assimilate it into their view of transportation policy.

And, finally, Florida benefits from the inherent advantage of being first. One of the things that makes high-speed rail possible for us is the fact that the technology is essentially in existence and there are numerous people, countries, companies, attempting to make theirs the one that breaks from the pack and becomes the first high-speed technology implemented in the United States.

Florida has the advantages of that. They can play vendors off against one another. They can seek contribution from those who seek to promote, and they have done that aggressively. That is an advantage that no other project will ever have in quite the same way as the first one. And so Florida has benefited from its own initiative.

What I would like to do before yielding to questions this morning is just to make some general comments that go beyond Florida to all of the high-speed rail projects that are underway in the country today. What I am really doing is talking to the committee, but talking through the committee to the promoters of the project on some of the things that they have to do.

Over the last three years I have watched the focus of attention on high-speed rail shift very gradually. A few years ago, the first time I went to a high-speed rail convention, the focus was just euphoria, the enthusiasm that comes with new horizons. The second year it had shifted from that into a kind of show-and-tell on technologies. But today when you talk to the high-speed rail promoters, the issues are issues of implementation—how do we get it done.

And if you look at those issues, I think there are two or three points that ought to be borne in mind, the first of which should be very important to this committee, given its jurisdiction.

First and most important, those who are promoting high-speed rail projects must be conservative in the preparation of their ridership and feasibility analyses because in the end, when these are all privately financed projects, the promoters will live or die on the extent to which inherently skeptical financial institutions view the credibility of these analyses.

Ridership studies in transportation, as this committee well knows, often tend to resemble expert witness testimony in court. If you know who hired the expert, you know what the outcome is going to be. And we can chuckle about that, and I do, but that type of defect is absolutely fatal if you are attempting to carry a new technology into the private financial markets.

Credibility is in the eyes of the beholder, and they are the beholders. I think the studies have got to be done professionally, they have got to be based on conservative assumptions.

And what we really need in this high-speed industry—and this is an area where the committee can take leadership, I think—is to develop uniform methodologies for ridership and revenue forecasting. We need to develop them by consensus and we need to insure that they are imposed uniformly on the projects being studied around the country.

And for those who are promoting the projects, I think they need to build their revenue estimates not on the best case scenario, but on the mid-case and the worst case scenario.

Finally, as communities around the country—and it is easier to say this in Florida than it is in other places, because we know the numbers are good here—as communities around the country begin to study the feasibility of high-speed rail, we have to begin those studies with a truly open mind and recognize that high-speed rail can work in many places but cannot work everywhere.

We have got to go into these studies with the recognition that some are going to come out negative. We have got to be prepared to accept that. In fact, the fact that some are negative gives credibility to the ones that are positive.

So credibility in financial forecasting I think is the major issue facing the movement today. And it is an issue where I think the committee can play a leadership role.

Second, I would caution all of the projects and the members of this committee who oversight them to be conservative in gauging their ability to compete for private capital.

Now, I do not think any serious analyst has questioned the ability of these projects to cover their operating costs; they do, in fact, cover their variable operating costs. They certainly will in Florida.

The Japanese and the French are each gaining between 15 and 20 percent returns above and beyond their operating costs, and I think on a good corridor like the Florida corridor they are going to generate enough cash to not only cover their operating costs, but to make a return on investment capital.

The issue is can they generate enough cash quickly enough to create a return that makes these projects competitive in financial markets? That is the issue. And the answer is I do not know. I do not think anyone can know.

The uncertainty of that factor coupled with the sheer magnitude of the dollars that have to be raised and the absolute newness of the technology mandate that the project promoters do everything they can creatively in the structuring of their projects to enhance the cash flow of these projects, particularly in the near term, and cash flow is the issue when you go into private capital markets.

There are many ways to do this. Few are as creative as Florida's. Florida has gone back to a system that was used in this country in the 1870s and '80s and '90s, the value capture system.

What Florida proposes to do is to grant exclusive development rights to the project franchise holder around the ingress and egress points on the system. Part of the franchise will be valuable pieces of property which can be developed by the franchise holder, and the cash flow from those pieces of property will enhance the cash flow from the project, to give it a better return.

That is not a new system. The trolley companies on the West Coast in the early part of this century regularly built stores around the ingress and egress points of their systems. If you go to Japan, you will see how they have developed stations. And it worked and can work again.

The question I always get on this is: Is this going to be enough, can it work? And the answer is: Of course it is, if you carry it far enough. And that is really the question of judgment and commitment for the communities.

How far do they have to go in enhancing the inherent economics of the project with real estate development, and are they willing to go that far. If they are, the project is going to work and it is really simply a matter of dollars and cents.

And I think there are other ways perhaps to enhance project cash flow. These are the types of issues that promoters have to deal with.

Third and finally—I could say many more things—I think I will stop here. I would give everyone the admonition to be patient, to take time to refine the concepts and to build a firm base of public support.

The objective is not necessarily to complete the project this afternoon. The objective is to complete it, to do it right, to build a firm base of public support. There are complex political issues in the development of high-speed rail.

Every community—it is funny, when the California project was started a few years ago, and this is a project that failed, the first time the communities along that line came into my office they were just thrilled with the concept of being served by a high-speed train. But a year later they began to recognize that they were not all going to be on stops, that in fact it was not going to be a high-speed train if it stopped at every one of those communities. And so the communities that were on the line but were unlikely to be served switched quickly and began to wage war on the whole project and ultimately toppled it.

These are complex issues that are political. What they did in California that was wrong is they went too quickly, they did not define their objectives and they did not consider the scope of what their constituency really was and bring the input of the communities into the service decisions that underlay the project.

Florida has not made that mistake so far. Florida has proceeded much more methodically and I think that is a good example, it is a good example for other places.

Breakthroughs in transportation that are truly historic rarely come in dramatic leaps. They come methodically in small steps that pave the way for big progress. That is what high-speed rail is all about and it is going to continue to be all about.

What is our role at FRA? We have been very active in this for a long time. I have before I came here, the agency since I am here. Fortunately we are in an area where the technologies are essentially developed. The question is how to implement them.

We have provided funding for feasibility studies on eight projects. We financed a large part of the feasibility study here in Florida and we continue to serve as a clearing house for technical data from all of these projects. We work with them almost on a weekly basis.

In addition, in an effort to take a step toward the development of uniform and credible methodologies for estimating ridership, we funded a joint research program with Northwestern University, looking at the disaggregate study approach. In addition, we sponsored two national seminars on estimation techniques.

FRA is also the lead agency in the environmental assessment of the Florida high-speed rail project, an assessment which is going to be a model for high-speed rail projects in other parts of the country.

It is also—and this is a big, big, near term issue—it is our responsibility to develop safety regulations and operational parameters for these technologies. The Shinkansen, the TGV technologies, let alone the MagLev, and others, really are not a glove fit with the safety rules and regulations that apply to railroads in this country.

Some of those regulations are going to have to be altered and in some respects the design of the systems coming into this country will have to be altered to meet our safety concerns.

We are now at the point where that is not a future issue. Florida is close enough to having to make some commitments on design that we at FRA will have to move in the next year into a serious assessment and into some decision-making on how we will alter our safety requirements to adapt to these trains and how the trains will have to alter their design to adapt to our safety needs. It is a major issue and we will be putting a considerable amount of time in on that in the next year.

Finally, I will continue to do exactly what I am doing this morning, which is go out to the public, go out to forums where decisionmakers are and lend credibility to the project by saying that those of us who are professionals in transportation, who do this for a living, consider these projects to be credible, consider them to be do-able.

There are no guarantees. It is going to take sound leadership, it is going to take a lot of vision, but if it is done right and if the leadership is there, these projects can come about and Florida can be the first.

We have all got a stake in that and it is a pleasure to be down here to convey that message this morning. And I really commend the committee, not just for this hearing, but those in Palm Beach ought to know that the chairman and Mr. Lewis—this is at least the third time that I can remember that the committee has officially or unofficially done something on high-speed rail, which I think puts them out ahead of any other committee on Capitol Hill.

And while the projects are basically private, that kind of support and that kind of interest is a good entre for them as they go into the private sector, so we all appreciate that.

Mr. Lewis. Thank you, John, for your excellent testimony and again for making an extra effort to get here from the blizzard in Canada.

Mr. Riley. It got easier when it started to snow.

Mr. Lewis. I think your opening comment is indicative of the problems we see, particularly with the airlines today, in trying to get from point A to point B. Certainly we need to look at the high-speed rail technology in order to fill this gap that we have, particularly in the two to three hundred mile range and in the intrastate application.

I am going to ask only a couple of questions. What is the Federal Railroad Administration planning in the future for any research support into high-speed rail technology?

Mr. Riley. We have not been involved in research outside of the safety area on high-speed rail. We have been in the safety area, and the reason for that is, frankly, lack of perceived need. I think one of the advantages we have in high-speed rail is that the technologies are in place and they have long service histories.

If you want to look at the steel wheel/steel rail technology, the Shinkansen has a service record of twenty years, TGV has a service record of five years. It is truly on-the-shelf technology.

Even going on to the next generation, which is the magnetic levitation technology, the basic operational design of magnetic levitation—there are two forms of it—has been the subject of substantial research in Japan at Miyazaki and at Emsland in Germany. I have been at those sites. The basic concept of the system, the design of the system, is pretty much developed.

Now what we have been holding up on are improvements in superconductivity. I think some of those have begun to be made. What they go toward is the cost of installing the system, but even in that area the implications of superconductivity go far beyond high-speed rail, and there are enormous, well-funded research projects on that for defense and other purposes.

We are lucky—we are lucky, because in the area of high-speed rail we do not have to spend a billion, billion and a half dollars and take ten years to re-invent this wheel.

Now, one of the most controversial issues—and I have just touched on it so I might as well raise it—is should we import foreign technologies. And that is controversial, but let me tell you why I think that.

The United States made a decision not to develop these technologies in the early '70s. I think one can argue that that was not necessarily a wise decision, but I think we do have to live with the consequences of it.

We have systems that are proven in practice available today. Were we to begin to develop a parallel system in the United States, we would be spending hundreds of millions of research dollars to develop something that already exists, and we would be putting back the installation time of this system in places like Florida by a decade.

And I do not think that is a wise public—in a sense, we have to live with the consequences of what we decided not to do a decade ago. I think there is a role for the United States in the development of the next tier of technologies and in the development of the heavy advance levitation technologies.

I think the basic design work on those technologies has been done, but where we will be involved—and this will largely be spinoff of defense research—is developing the component parts.

These developments on superconductivity are very important, particularly to the Japanese design. The JNR system operates on this basis. The JNR system features a superconducting magnet which operates by inducing a repelling magnetic field on passive coils that are set in a U-shaped guideway.

The issue there is the cost of maintaining the temperatures necessary to preserve the superconductivity of that magnet, which is set in an interior post on the train itself.

Now, as we can develop cheaper systems, it becomes more and more cost viable. The bottom line of this is, I do not think we are wise to invest our dollars in redeveloping things that exist.

Although we may import a design from another nation, the jobs will be here, the production will be here, the construction will be here, and what we are really gaining here is that we are gaining close to a billion dollars in research money that we did not invest and we are taking advantage of the perhaps unfortunate decision that we did not invest it.

We are going to continue to spend money on safety. When Federal research dollars became very scarce a few years ago, we had to make a decision on how we were going to spend ours. I decided first that I was going to save our research program, and I did. We did not lose ours as many other agencies did.

In fact, I came—this year we actually came in with a request for an increase in our safety research dollars at FRA, which is in the administrative budgeting sense about the equivalent of negotiating a test ban treaty, I think.

But we decided that when research dollars became scarce, that we were going to focus them on safety-related research with no direct cost benefit—the types of research that no one else has an incentive to do but us. And we were not going to try to duplicate research that private parties or the defense establishment has both an incentive and a capacity to perform.

The question, I think, Mr. Lewis, is a very good question and it is a big question. I have tried to hit the different areas and parameters of it for you, but those are what our intentions are.

Mr. Lewis. I would like to explore with you just for a moment, John, on the superconductivity in the MagLev.

As I mentioned in my opening statement, in Houston our scientists came up with a new system using different alloys in the magnetic cores. They could cool them much more cheaply than we have been in the past by using helium, because the only alloy that is available right now requires that you are running at almost absolute zero, which is high-cost cryogenics. But by using liquid nitrogen, which is the breakthrough that they came through with, we are talking about 20 to 30 times less the expense.

Is there any way that the Federal Railroad Administration could run research into that? I certainly would hate to see that technology taken away from the United States at this point.

Mr. Riley. Well, I think that this is an opportunity for the United States to do what I have been arguing we ought to do for years. Up to this point other nations have been so far ahead of us on magnetic levitation that we frankly have not had a lot to offer.

Now we do have something to offer, and it is an opportunity for us to begin to enter joint ventures. We can begin joint venture with the Japanese, with the Germans and others who are working in this area.

In that way we can take advantage of their design developments, they can take advantage of our technological developments and we could each go forward without having to retrace the steps of the past.

I hope to be in the Far East a little later this spring when the Congressional hearing season begins to wind down a little bit. And that is one of the issues I intend to explore with the Japanese.

We are looking now in the wake of these superconductivity developments at what the state of superconductivity research is, who is funding it, where is it going. And I cannot tell you that, as I sit here this morning, I have made the decision yet whether we can play an additive role or not. But it is not something that we have turned our back on and we are prepared to address that if we find there is—on MagLev—there are two different systems here, and it is important to understand their distinction. The German system works differently than the Japanese system.

The German system works on an active suspension principle. What it does is it uses a feedback system that controls attracting magnets. The Japanese system is different, and that uses a superconducting magnet which operates by inducing a repelling force, a repelling magnetic field and passive coils set in a guideway.

So the superconductivity, while the developments there are relevant to both systems, have an extremely strong application to the Japanese concept. What we need to do now, I think, is take an assessment of where they are, where we are, are the funds available from private or defense sources and is there a need to supplement.

I would raise those questions for you, as you have raised them for me. I cannot answer them at this point, but we are on our way to answering them and that is a relevant question.

Mr. Lewis. Thank you, John.

Mr. Chairman?

Mr. McCurdy. Thank you, Tom.

And again thank you, Mr. Riley, for your appearance today and your testimony. I think you have done a very good job outlining the role of the Federal Government.

I would have to concur with the statements of our colleague from Wisconsin that the issue, of course, is going to be economic feasibility along with technological feasibility. And I was interested in your statement about the uniform methodologies in establishing the criteria for feasibility.

Would you just briefly summarize those again for the record?

Mr. Riley. Yes, I will.

I think one of the difficulties that the promoters of privately financed high-speed rail projects are going to have to deal with is an inbred skepticism that the success these systems have had in the demographics of other countries can be replicated here, where our principal investment has been in an interstate highway system and in an air system that it without—for all of its problems—is without peer in Europe or Japan, where these systems are now in place.

The basis of that argument has to be ridership estimation. Ridership estimation is an inherently inexact science. The studies, if they are going to be treated credibly by people who are being asked to put millions and possibly billions of risk dollars into these projects, are going to have to be conservative by any definition.

Moreover, today we suffer from a lack of benchmarks—a lack of benchmarks. It is difficult to look at a ridership study done on one project and relate it to another project. As a consequence, successes and failures are not necessarily mirrors from which the capability of other projects can be judged.

That uncertainty alone has as much potential to slow down the high-speed rail development as any other issue I can think of. Now the High-Speed Rail Association in recent years has attempted to come up with voluntary agreement on the parameters that should underlie ridership studies.

I think that the most important developmental area that we can deal with today is to work with the parties to come up with, or perhaps design for the parties, uniform criteria for ridership estimation and then to insure—using the High-Speed Rail Association as a vehicle, to insure that those criteria really are applied to all the projects.

You know, it comes down under the heading that life is not fair. I mean, I think everyone believes in their ridership studies, but in the end the only audience that counts is the audience on Wall Street, because they are the ones in the end that will provide the money or that will not provide the money. And so one has to get a sense of what they consider credible and then build our parameters around that.

I think Florida has one of the best ridership studies. I was very pleased with it when it came back. I think the money we invested in it was well spent. It is conservative, it does not lean too heavily on induced demand.

The big change in ridership studies in recent years is that three or four years ago the principle used to be to look at really only two variables: population movements and system demographics. They were aggregate studies.

Today's ridership technology, estimation technology, has shifted a little bit and gone to a disaggregate mode. They look at the population as being somewhat more complex and try to determine how different demographic groups within a population will be affected by the option of high-speed rail. It is a better estimating model. It is a more complex one.

I emphasize, in putting this in the record for you as you requested, that one bad ridership study on one project that induces investors to put money into something that does not prove true will effectively end the movement toward high-speed rail. No one can afford that. Every one of these projects has a stake in insuring that all the others operate within the real world. I think that is a very real, very immediate issue—very real.

Mr. McCURDY. Do you have any study results on the economic impact of high-speed rail in terms of jobs provided and income brought into a community?

Mr. **Riley.** We have not done an aggregate study on it. Each of the high-speed rail project promoters has done a study on that in their community and they, I am sure, are—that is a good question to ask the representatives of the groups that are to come before the committee this morning.

We have tended to look more at the technical end of it.

Mr. **McCurdy.** Well, of course, this subcommittee is to look at the technical end also, and to also benefit from the developments in technology, and we are extremely interested in some of the testimony and demonstrations today.

I would like to say also—and I know my colleagues would concur—Florida does—appears to be in a unique position. I met with Senator Graham on this issue and most of the Florida delegation. Mr. Lewis, Mr. Mica, people from other parts of the state have been extremely interested in this.

And again the Federal role is perhaps more limited than some people might like, especially Florida. But it does appear that this is farther along than any other system.

We appreciate your testimony and your taking the time to join us today.

Tom.

Mr. **Lewis.** Mr. Sensenbrenner?

Mr. **Sensenbrenner.** I have no questions, Mr. Chairman.

Mr. **Lewis.** I have just one final question for you.

How about telling us about the Federal Highway and Federal Railroad Administration's research in safety of high-speed rail? Is it really a safe system?

Mr. **Riley.** High-speed rail systems, at least in their operation and practice in France and Japan, have proven to be extremely safe. They operate on dedicated track, which is something we do not have here in the United States.

When I say dedicated track, I mean only the high-speed rail operates on that track. There is no freight on the track, there is no lower-speed rail in the zones where the trains actually operate at high speed.

The Shinkansen has operated for two decades without a fatality. The TGV has a comparable record for its shorter period of operation in France.

It is not generally true that overseas systems have better safety records than ours. In fact, American trains in general have much better safety records than their counterparts overseas. But the high-speed technologies have very, very good and sound safety records and, curiously enough, much of the technology that is used to assure safe operations is American technology. We are ahead by far of our overseas competitors in safety technology.

Now what we have to do—many of the rules and regulations that the Federal Railroad Administration has written over time are rules and regulations designed for our conventional blocking systems, for conventional speed trains.

The language and the concepts just do not adapt to trains operating at 180 miles an hour with magnetic levitation technologies. Even the types of inspections that one does and standards that one puts into place do not become relevant when you get to speeds that high and technologies that different from conventional diesel-electric technology.

We have got to rewrite those things. I took the position a couple of years ago that we would devote the time to re-evaluating and rewriting those regulations when the first high-speed rail project got close enough to fruition that it was really worth the investment of our time to do.

Now I think we are there. And the reason I think we are there is that when Florida makes its designation decisions in 1988 and '89, they have got to know what technology they are dealing with.

They have got to know—the vendors have got to know what adaptions they need to put on their own technology. We have got to give them a base from which to make those decisions, so we are moving in that direction.

I think that, you know, in the abstract one could argue here that there might be a role for Federal research here on the adaption of these systems to our safety standards. That is true in the development of those standards and we are doing that.

But I have found that there is such an enormous stake for the vendors in winning these contracts that they are generally willing to make themselves the adaptions that have to be made to make these systems sellable here.

I think having made what might not have been a very wise decision not to be in the forefront of development in these technologies, we at least ought to get the best advantage we can out of the downside of that decision by importing those decisions.

Mr. LEWIS. Well, thank you, John.

Are there any further questions?

[No response]

Mr. LEWIS. Thank you again. We again appreciate you making this fast trip down here and being with us this morning.

Mr. RILEY. Well, Mr. Chairman, I appreciate the leadership that you are providing and I hope that I will be down here again to help cut the ribbon on this thing sometime in the early part of the next decade, because I think it is going to happen. I think it can happen.

Mr. LEWIS. Thank you, John.

Mr. LEWIS. The next panel is from the State of Florida. We have Mr. Bill Miller, Deputy Assistant Secretary for the Florida Department of Transportation, and Charles Smith, the Executive Director of the Florida High-Speed Rail Transportation Commission.

STATEMENTS OF BILL MILLER, DEPUTY ASSISTANT SECRETARY, FLORIDA DEPARTMENT OF TRANSPORTATION; AND CHARLES SMITH, EXECUTIVE DIRECTOR, FLORIDA HIGH-SPEED RAIL TRANSPORTATION COMMISSION

Mr. LEWIS. Gentlemen, your entire statements will be included in the record and we would like to ask you, if you could, to summarize it in ten minutes.

Mr. MILLER. Mr. Chairman, members of the committee, Secretary Henderson regrets that he could not be here today, and I am pleased to appear before you in his stead.

Florida's high-speed rail project will be one means of solving the state's emerging transporation needs problem. Florida, as the rest of the country, relies on its transportation network much as the body relies on its circulatory system. All of it has to work very well together in order for us to be viable.

I would like to quote from the Florida Comprehensive Plan, which guides all levels of government in our state about the business of transportation, and I quote:

"For the State Transportation System to work effectively, all levels of government, responsible transportation agencies and the private sector must coordinate their activities. Furthermore, each transportation mode should be viewed as an element in the state's integrated transportation system . . ."

And continuing, "All transportation modes should be linked to form an integrated transportation system. Transportation systems and improvements should be coordinated with land use and development decisions and should be selected and funded based on their relative transportation efficiency."

And that is a major part of our transportation guidance in our state comprehensive plan.

Florida's phenomenal growth has already outstripped current road capacity in several urban areas—eight, as a matter of fact. And with a growth rate of over 300,000 persons per year, we simply cannot depend on new roadways alone.

The situation is likewise for aviation travel, as Florida ranks second in the nation in civilian air operations. This is particularly true in central and southeast Florida.

The department's transportation plan recognizes and highlights the fact that there are critical needs to be met in our transportation system. A new direction for transportation was the essence of the Florida transportation plan recently published last year and adopted by the legislature.

New policies sensitive to those established in the state comprehensive plan will redirect some of the thinking and actions of this department. There must be a shift, especially in urban areas, to other mode improvements such as public transportation. Along with buses and ride sharing, there is a mass transit mode that plays an important part in Florida's transportation solutions.

Despite the decline in rail travel in this country, we have sparked a renewed interest in this form of public transportation. As Congressman Lewis knows, we are less than eighteen months away from initiating new rail service in this part of the state.

And on that point, Congressman, we are most appreciative of the work of Administrator Riley and his staff, technically and financially, in aiding us in putting this system in place.

Even more importantly, we are in the midst of negotiations with the CSX Railroad Company to purchase a rail corridor between West Palm Beach and Miami. Should this acquisition become a reality, it will contribute to the long-term viability of rail service in southeast Florida and, by design, preserve options for high-speed rail.

High-speed rail transportation has been in the planning stages in Florida since 1982. It is now reaching the juncture where the request for proposals has been released and potential applicants are formulating their responses.

In 1984 the legislature recognized the importance of a high-speed rail project for Florida. It crafted the High-Speed Rail Act, which established a High-Speed Rail Transportation Commission to conduct the planning and award the franchise for what is predicted to be between a two and five billion dollar project.

Defined as a system capable of traveling in excess of 120 miles per hour, this high tech, new transportation alternative would carry passengers between major population centers and provide for population expansion beyond the current core population centers where most of our population resides.

The system will link Hillsborough, Pinellas, Orange and Dade Counties with stops in between, where economically and environmentally feasible. It also will serve as a backbone for integrating other transportation systems, whether they be new commuter rail service, park and ride facilities linking the highway systems or connections to our major airports.

This 300-plus mile system causes a focused and compact growth pattern that will prove beneficial to current environmental and growth management plans. The High-Speed Rail Act requires full consideration of those impacts before the awarding of the franchise.

This hearing of the Subcommittee on Transportation, Aviation and Materials is an important coalescing of the transportation modes and specifically the technology involved in one type of transportation, high-speed rail. Testimony by experts later this morning will include the details of the high-speed project and various technologies that might be used in the Florida system.

They are high tech, state of the art packages and will give the state dramatic transportation technology and capacity for the 21st century. Mobility is progress and this means of transportation in conjunction with other systems will afford the state the continued ability to be a national leader in providing a progressive transportation system.

With Florida's burgeoning population, public transportation will necessarily play a much larger role in our transportation network in years to come We all will be working to coordinate the various modes of transportation. We must plan with vision and execute expeditiously what our state will need. High-speed rail transportation is a very key element of that mix.

Florida's 150th birthday is 1995 and we will see at that point in time our high-speed rail transportation system breaking new ground.

Thank you, Mr. Chairman. I appreciate that.

[The prepared statement of Bill Miller follows:]

STATEMENT
OF
WILLIAM W. MILLER, DEPUTY ASSISTANT SECRETARY
FLORIDA DEPARTMENT OF TRANSPORTATION
TO THE
SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

PALM BEACH COUNTY COMMISSION CHAMBERS
FIRST FLOOR
200 2ND STREET
WEST PALM BEACH, FLORIDA
9:00 A.M. - 12:00 NOON

APRIL 3, 1987

INTRODUCTION

MR. CHAIRMAN, MEMBERS OF THE COMMITTEE, SECRETARY HENDERSON REGRETS HE COULD NOT BE HERE TODAY. I AM PLEASED TO APPEAR BEFORE THE COMMITTEE IN HIS STEAD TO DISCUSS FLORIDA'S PACE-SETTING HIGH SPEED RAIL PROJECT AND HOW IT INTEGRATES WITH OUR OVERALL TRANSPORTATION PLANNING FOR THE FUTURE.

FLORIDA'S HIGH SPEED RAIL PROJECT WILL BE ONE MEANS OF SOLVING THE STATE'S EMERGING TRANSPORTATION NEEDS. FLORIDA, AS WELL AS THE REST OF THE COUNTRY, RELIES ON ITS TRANSPORTATION NETWORK MUCH AS THE BODY RELIES ON ITS CIRCULATORY NETWORK. ALL OF IT HAS TO WORK TOGETHER FOR THE WHOLE TO BE VIABLE.

OVERALL TRANSPORTATION PLAN

FLORIDA'S TRANSPORTATION PLAN DOCUMENT CONCLUDES IN PART, "FOR THE STATE TRANSPORTATION SYSTEM TO WORK EFFECTIVELY, ALL LEVELS OF GOVERNMENT, RESPONSIBLE TRANSPORTATION AGENCIES AND THE PRIVATE SECTOR MUST COORDINATE THEIR ACTIVITIES. FURTHERMORE, EACH TRANSPORTATION MODE SHOULD BE VIEWED AS AN ELEMENT IN THE STATE'S INTEGRATED TRANSPORTATION SYSTEM.

"ALL TRANSPORTATION MODES SHOULD BE LINKED TO FORM AN INTEGRATED TRANSPORTATION SYSTEM. TRANSPORTATION SYSTEMS AND IMPROVEMENTS SHOULD BE COORDINATED WITH LAND USE AND DEVELOPMENT DECISIONS AND SHOULD BE SELECTED AND FUNDED BASED ON THEIR RELATIVE TRANSPORTATION EFFICIENCY."

FLORIDA'S PHENOMENAL GROWTH HAS ALREADY OUTSTRIPPED THE CURRENT ROAD CAPACITY IN SEVERAL URBAN AREAS. AND WITH A GROWTH RATE OF 326,000 NEW PERSONS PER YEAR, WE SIMPLY CANNOT DEPEND ON NEW ROADWAYS ALONE. THE SITUATION IS LIKEWISE FOR AVIATION TRAVEL AS FLORIDA RANKS SECOND IN THE NATION IN CIVILIAN AIR OPERATIONS.

THE DEPARTMENT'S TRANSPORTATION PLAN RECOGNIZES AND HIGHLIGHTS THE FACT THAT THERE ARE CRITICAL NEEDS TO BE MET IN OUR TRANSPORTATION SYSTEM. A NEW DIRECTION FOR TRANSPORTATION WAS THE ESSENCE OF THE FLORIDA TRANSPORTATION PLAN. NEW POLICIES, SENSITIVE TO THOSE ESTABLISHED IN THE STATE COMPREHENSIVE PLAN WILL REDIRECT SOME OF THE THINKING AND ACTIONS OF THE DEPARTMENT. THERE MUST BE A SHIFT, ESPECIALLY IN URBAN AREAS, TO OTHER MODAL IMPROVEMENTS SUCH AS PUBLIC TRANSPORTATION. ALONG WITH BUSES AND RIDE SHARING, THERE IS A MASS TRANSIT MODE THAT PLAYS AN IMPORTANT PART IN FUTURE TRANSPORTATION SOLUTIONS.

INTEGRATION OF HIGH SPEED RAIL TRANSPORTATION INTO THE PLAN

DESPITE THE DECLINE IN RAIL TRAVEL IN THIS COUNTRY -- A TREND CAUSED BY THE AUTOMOBILE'S CONVENIENCE FACTOR -- WE HAVE SPARKED A RENEWED INTEREST IN THIS FORM OF PUBLIC TRANSPORTATION. AS CONGRESSMAN LEWIS KNOWS, WE ARE LESS THAN 18 MONTHS AWAY FROM INITIATING NEW COMMUTER RAIL SERVICE IN THIS PART OF THE STATE. EVEN MORE IMPORTANTLY, WE ARE IN THE MIDST OF NEGOTIATIONS WITH THE CSX RAILROAD TO PURCHASE THE RAIL CORRIDOR BETWEEN WEST PALM BEACH AND MIAMI. SHOULD THIS ACQUISITION BECOME A REALITY, IT WILL CONTRIBUTE TO THE LONG TERM VIABILITY OF RAIL SERVICE IN SOUTHEAST FLORIDA, AND BY DESIGN, PRESERVE OPTIONS FOR HIGH SPEED RAIL.

HIGH SPEED RAIL TRANSPORTATION HAS BEEN IN THE PLANNING STAGES IN FLORIDA SINCE 1982. IT IS NOW REACHING THE JUNCTURE WHERE THE REQUEST FOR PROPOSALS HAS BEEN RELEASED AND POTENTIAL APPLICANTS ARE FORMULATING THEIR RESPONSES.

IN 1984, THE LEGISLATURE RECOGNIZED THE IMPORTANCE OF A HIGH SPEED RAIL PROJECT FOR FLORIDA. IT CRAFTED THE HIGH SPEED RAIL ACT WHICH ESTABLISHED A HIGH SPEED RAIL TRANSPORTATION COMMISSION TO CONDUCT THE PLANNING AND AWARD THE FRANCHISE FOR WHAT IS PREDICTED TO BE A $2 - $5 BILLION PROJECT.

DEFINED AS A SYSTEM CAPABLE OF TRAVEL IN EXCESS OF 120 MPH, THIS HI-TECH, NEW TRANSPORTATION ALTERNATIVE WILL CARRY PASSENGERS BETWEEN MAJOR POPULATION CENTERS AND PROVIDE FOR POPULATION EXPANSION BEYOND THE CURRENT CORE POPULATION CENTERS WHERE MOST OF OUR POPULATION RESIDES.

THE SYSTEM WILL LINK HILLSBOROUGH/PINELLAS, ORANGE AND DADE COUNTIES WITH STOPS IN BETWEEN WHERE ECONOMICALLY AND ENVIRONMENTALLY FEASIBLE.

IT ALSO WILL SERVE AS A BACKBONE FOR INTEGRATING OTHER TRANSPORTATION SYSTEMS -- WHETHER THEY BE NEW COMMUTER RAIL SERVICE, PARK AND RIDE FACILITIES LINKING THE HIGHWAY SYSTEM, OR CONNECTIONS WITH MAJOR AIRPORTS.

THIS 300 + MILE SYSTEM CAUSES A FOCUSED AND COMPACT GROWTH PATTERN THAT WILL PROVE BENEFICIAL TO CURRENT ENVIRONMENTAL AND GROWTH MANAGEMENT PLANS. THE HIGH SPEED RAIL ACT REQUIRES FULL CONSIDERATION OF THOSE IMPACTS BEFORE THE AWARDING OF THE FRANCHISE.

CLOSING

THIS HEARING OF THE SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS IS AN IMPORTANT COALESCING OF THE TRANSPORTATION MODES AND SPECIFICALLY THE TECHNOLOGY INVOLVED FOR ONE TYPE OF TRANSPORTATION -- HIGH SPEED RAIL.

TESTIMONY BY EXPERTS LATER THIS MORNING WILL INCLUDE THE DETAILS OF THE HIGH SPEED RAIL PROJECT AND THE VARIOUS TECHNOLOGIES THAT MAY BE USED FOR THE FLORIDA PROJECT. THEY ARE HI-TECH, STATE-OF-THE-ART PACKAGES AND WILL GIVE THE STATE DRAMATIC TRANSPORTATION TECHNOLOGY FOR THE 21ST CENTURY.

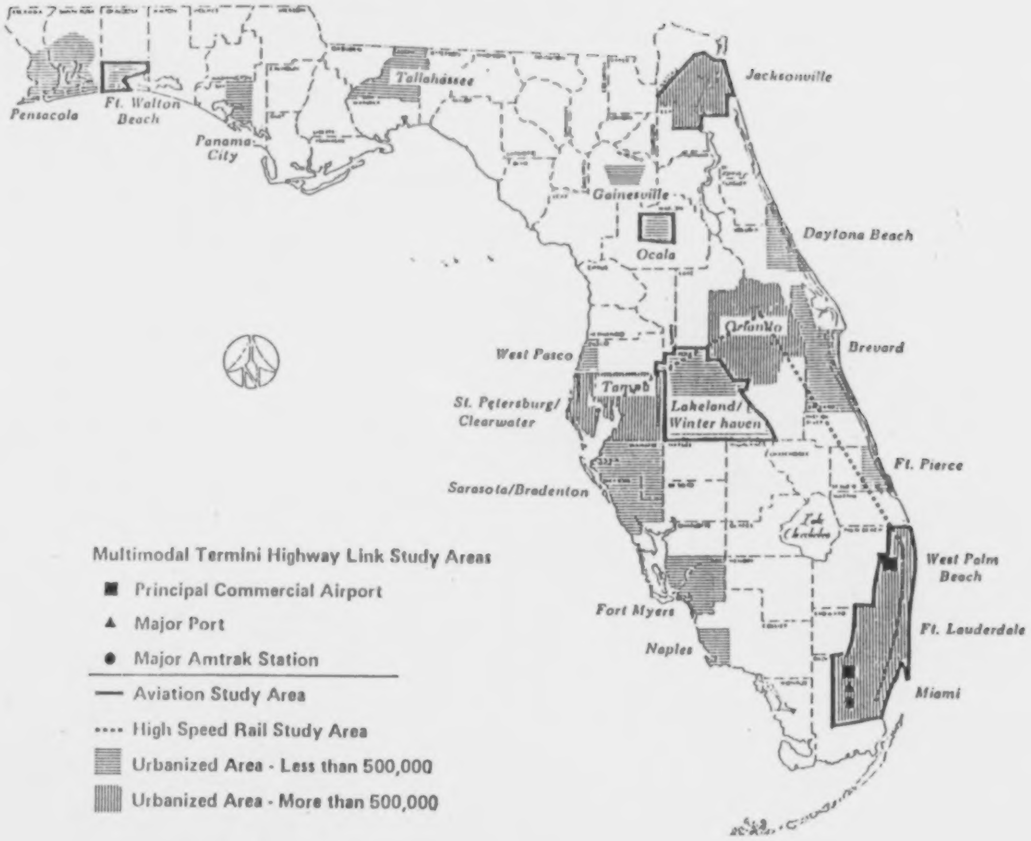
MOBILITY IS PROGRESS. AND THIS MEANS OF TRANSPORTATION IN CONJUNCTION WITH OTHER SYSTEMS WILL AFFORD THE STATE THE CONTINUED ABILITY TO BE A NATIONAL LEADER IN PROVIDING A PROGRESSIVE TRANSPORTATION SYSTEM.

WITH FLORIDA'S BURGEONING POPULATION, PUBLIC TRANSPORTATION WILL NECESSARILY PLAY A MUCH LARGER ROLE IN OUR TRANSPORTATION NETWORK IN YEARS TO COME. WE ALL WILL BE WORKING TO COORDINATE THE VARIOUS MODES OF TRANSPORTATION. WE MUST PLAN WITH VISION

AND EXECUTE EXPEDITIOUSLY WHAT OUR STATE WILL NEED. HIGH SPEED RAIL TRANSPORTATION IS A KEY ELEMENT IN THAT MIX. FLORIDA'S 150TH BIRTHDAY IN 1995 WILL SEE US AS THE LEADER IN THE NATION WITH OUR HIGH SPEED RAIL SYSTEM STREAKING ACROSS THE STATE.

THANK YOU, MR. CHAIRMAN. I'D BE HAPPY TO ANSWER ANY QUESTIONS.

MULTIMODAL TERMINI, AVIATION, AND
HIGH SPEED RAIL STUDY AREAS


Pensacola
Ft. Walton Beach
Panama City
Tallahassee
Jacksonville
Gainesville
Ocala
Daytona Beach
Orlando
Brevard
West Pasco
Tampa
St. Petersburg/Clearwater
Lakeland/Winter haven
Ft. Pierce
Sarasota/Bradenton
Lake Okeechobee
West Palm Beach
Fort Myers
Ft. Lauderdale
Naples
Miami
Multimodal Termini Highway Link Study Areas
■ Principal Commercial Airport
▲ Major Port
● Major Amtrak Station
— Aviation Study Area
···· High Speed Rail Study Area
▤ Urbanized Area - Less than 500,000
▥ Urbanized Area - More than 500,000

Supporting Information

Submitted by Florida High Speed Rail
Transportation Commission
to
Field Hearing
Subcommittee on
Transportation, Aviation and Materials
Committee on Science, Space and Technology
April 3, 1987
West Palm Beach, Florida

Summary

The Florida High Speed Rail Act of 1984 created a seven member Commission to plan and award a franchise for the financing, construction and operation of a high speed rail system in Florida. This mandate is being carried out by the Commission which issued a Request For Proposals in early 1987 and plans to award a franchise in 1991.

The Florida Project will be primarily a private sector initiative with certain incentives, mainly right-of-way and expedited environmental and land use procedures, offered by the state government. Any high speed rail system capable of operating at 120 mph can be proposed for the Florida project. Several domestic and international business groups are preparing proposals to compete for the franchise award.

The Florida High Speed Rail Concept

The State of Florida has taken the first of several steps toward implementing a modern state-of-the art high speed ground transportation system to connect and serve its rapidly growing urban population centers. Although the need to plan for new forms of transportation was recognized in a number of studies undertaken in the mid-seventies, serious work toward a high speed transport system for Florida began in 1982. In April of that year, a High Speed Rail Transportation Committee was created by executive order to undertake a feasibility study for a high speed rail transportation system in the State of Florida.

Under the direction of this Committee, composed of business and government leaders, an assessment of high speed rail operations and advanced ground transportation technology throughout the world was undertaken. Members of this Committee traveled worldwide at their own expense to inspect and observe systems operating in revenue service as well as systems under research and development.

From these inspection visits and through discussion with representatives of the business organizations and government agencies involved in the development and operation of those systems, a feasibility study to determine whether a HSR system could be constructed and operated as a public/private sector co-venture in Florida was completed.

This study examined all of the major factors essential to understanding the requirements and ramifications for financing, constructing and operating a cost effective system. The topics addressed were:

- o Economic Analysis
- o Corridor Alternatives
- o Financial Consideration
- o Economic Benefits
- o Environmental and Land Use Impacts
- o Technology
- o Operating and Management

The feasibility study examined each of these factors and reached the conclusion that a high speed rail system was feasible in the State of Florida.

The Need For High Speed Rail

Some of the main reasons for this conclusion lie in the unique economic and physical characteristics of the state. Although Florida has grown in fits an starts over the years, the massive growth we are seeing today is a relatively new phenomena. The 1940 population of Florida was two million and then only double what it was in 1900. Even in 1960 when the population was slightly over five million, Florida was basically a rural state with only a few pockets of major urbanization. However, by 1980 the population had grown to about ten million and several major urban complexes had emerged.

In 1984, Florida was the sixth largest state and by the year 2000 will probably be third or fourth in terms of total population. Only California, New York and possibly Texas will exceed Florida's approximately 15 million population.

This surge in growth was initially attracted by the climate and other environmental amenities which first attracted agricultural industry and later grew on the large tourist industry. In more recent years, Florida's economic base has diversified to include strong hi-tech, space oriented enterprises and major banking and insurance centers. These trends are continuing.

However, in planning and designing for a High Speed Rail System for Florida it is necessary to minimize the adverse impact of such a system on the state's fragile ecosystem. Florida has some of the most stringent environmental, land use and growth management laws and regulations in the country, and the High Speed Rail System Request For Proposals (RFP) is a major force in implementing these policies.

Economic Benefits

The resulting economic benefits derived from a high speed rail system are evident in the statistical projections. Due to the primarily private sector nature of the project, there will not be a drain on the state resources. The building and operation of the system over a 25 year period is significant. Tourism dollars for travel on the system and the spill-over to other tourist spending by these passengers will increase about $17 billion. Construction of the system will bring another $800 million in increases and operations of the line would net about $700 million.

Corridor Alternatives

A number of potential travel corridors were analyzed for high speed rail operations. The primary travel corridor in the state was shown to be the Hillsborough/Pinellas, Orange and Dade County corridor. It was selected as the base line for a detailed technology assessment, ridership and revenue projections and cost estimates in the feasibility study. Figure 1 illustrates these primary routes.

Table 1 Shows the estimated patronage for several generic high speed rail systems operating at various speeds, frequencies and station stops. Revenues generated from these ridership estimates are projected to cover operating costs and some of the capital for building the system.

FIGURE 1

FLORIDA HIGH SPEED RAIL TRANSPORTATION COMMISSION

POTENTIAL HIGH SPEED RAIL CORRIDORS

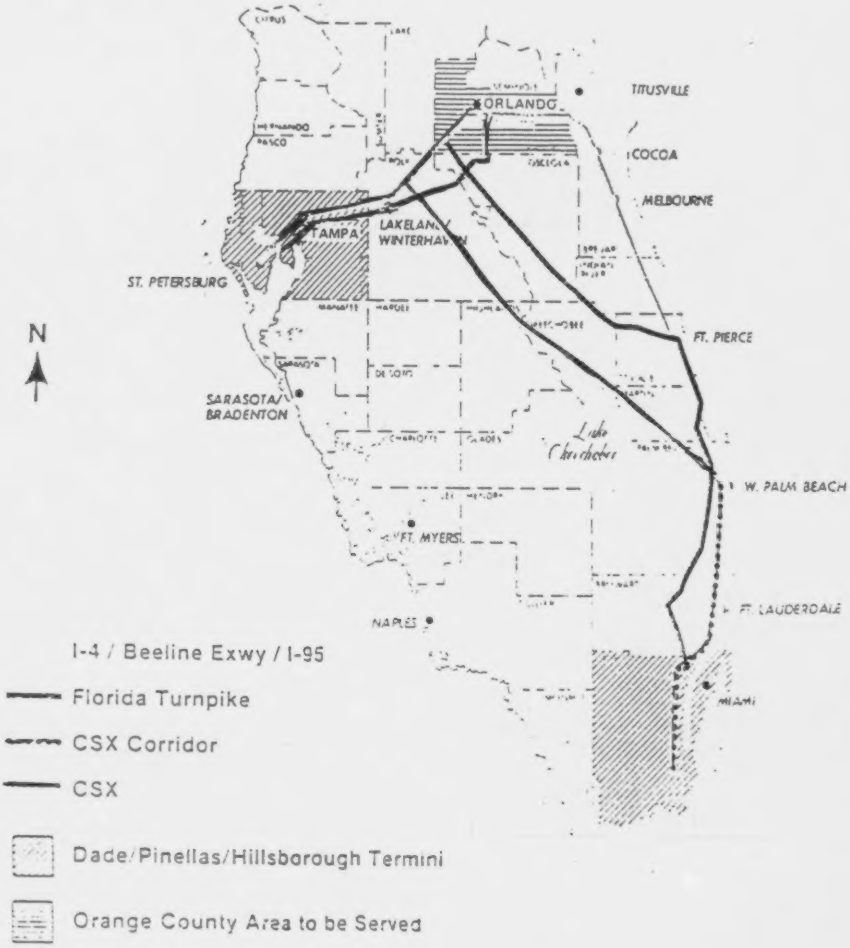

CITRUS
LAKE
SEMINOLE
ORLANDO
TITUSVILLE
HERNANDO
PASCO
POLK
OSCEOLA
COCOA
MELBOURNE
TAMPA
LAKELAND/WINTERHAVEN
ST. PETERSBURG
MANATEE
HARDEE
OKEECHOBEE
FT. PIERCE
N
SARASOTA
DE SOTO
SARASOTA/BRADENTON
CHARLOTTE
GLADES
Lake Okeechobee
W. PALM BEACH
LEE
HENDRY
FT. MYERS
FT. LAUDERDALE
NAPLES
MIAMI
I-4 / Beeline Exwy / I-95
Florida Turnpike
CSX Corridor
CSX
Dade/Pinellas/Hillsborough Termini
Orange County Area to be Served

TABLE 1

Florida High Speed Rail Study

ESTIMATED HIGH SPEED RAIL PATRONAGE

Service Option			Estimated Annual Patronage
Speed	Daily Trains	Stations	
120 MPH	8	8	1.8 million
120	16	8	2.3
160	8	8	2.1
160	16	8	2.5
250	8	8	2.1
250	16	8	2.8

Because the initiation and completion of the Florida High Speed Rail System is dependent on private sector financing and market conditions, the primary corridor will not preclude other corridors or alternate destinations from being considered by potential franchisees, should market conditions or other factors warrant. It should be emphasized that the specific route alignment and station location will be determined by the HSR builder although the Commission may provide certain right-of-way or other properties for HSR facilities.

The Public/Private Development Strategy

A unique and innovative feature of the Florida High Speed Rail Program is the co-venture of public and private initiatives to permit private enterprise to build and operate the High Speed Rail System. A number of financial instruments and other incentives are available through the Florida High Speed Rail Act to accomplish this objective.

Development Rights

The most unique and powerful tool in the Florida Act is the creation of exclusive development rights for the HSR franchisee. These development rights are a major potential source of funding available to the high speed rail franchisee and are an exclusive right to develop substantial acreage and square footage for residential, commercial, industrial or recreational uses. These development rights will be assigned to the high speed rail franchisee at the time of the franchise award. They may apply to property which has been acquired by the franchisee or to prototype master plans that are proven necessary to finance the high speed rail project. In effect, the Florida High Speed Rail Act will grant these exclusive rights as a means of creating a valuable asset to provide the funding for the high speed rail system. These development rights may also be conveyed to a third party or may be used as leverage for bonding purposes on behalf of the franchisee.

Eminent Domain Authority

The Commission is also vested with the power, through the Florida DOT to exercise "power of eminent domain" or condemnation to acquire property on behalf of selected franchisees. Once property is acquired by eminent domain the Commission can then convey use of the acquired property through sale or lease under terms approved by the governor and cabinet. Property so acquired may be used for either construction of the rail line or for related developments that are necessary in financing of the system.

Use of Highway Right-of-Way and Other Public Lands

Under the Florida High Speed Rail Act, the Florida DOT is directed to grant use of highway right-of-way for high speed rail purposes consistent with state and federal laws and consistent with the operational needs of the highway system. Use of interstate and other highway rights of way could be a significant factor in the route alignment for the high speed rail system and could substantially improve the financial viability for the system. The RFP requests proposers to maximize the use of existing rights-of-way as a way of reducing costs and environmental affects.

Station Site Properties

A number of local jurisdictions and property owners have designated substantial parcels of property for high speed rail purposes as an incentive for the location of high speed rail stations in those jurisdictions or on the private property. Substantial benefits would accrue to the property owner in terms of increasing the value of that property, but also provides the high speed rail franchisee with low cost or no cost property acquisitions. Local governments by dedicating these station sites would enhance their tax base and provide development opportunities in the jurisdiction and in large measure control land use developments.

In addition to these specific funding mechanisms, the Florida High Speed Rail Act also authorizes the Commission to provide for a number of other incentives. Among the most important are:

Issuance of Bonds

Although the bonding authority of the Commission is limited in that there can be "no pledge of full faith and credit" the availability of this financing mechanism may be significant in ensuring a full financing package for selected franchisees. Of equal or greater importance may be whether the bonds receive federal tax exempt status which would permit them to be sold at a lower interest rate. The Commission has taken steps to secure tax exempt status for HSR projects through Congressional action.

Development Impact Fees

Under this approach, all new development within a prescribed area surrounding HSR stations could be required to pay a flat fee to support the system and related infrastructure cost for the station area serving the project. The state already uses funds for infrastructure associated with developments.

Equipment Lease Financing

This funding instrument can be structured through a leveraged lease offered to investors for sale of depreciation rights on equipment or through an equipment trust. In addition, most foreign manufacturers have access to export credits for financing system elements constructed in their country.

Tax Increment Revenue Financing

With local consensus and a voter approved intergovernmental agreement with local jurisdictions, tax increment financing revenue could be used to fund a portion of the capital cost of a high speed system. Currently, this revenue source can be applied only in areas where urban renewal districts have been established. This financing mechanism could be appropriate to high speed rail facilities located in existing urban areas.

Station Cost Sharing/Connector Fees

Station cost sharing agreements are directly relevant to the sale of the development rights associated with the high speed rail franchisee. Under a station cost sharing program, developers would purchase development rights to transit station buildings and would also agree to incur major portions of the station's capital cost.

Land Use and Environmental Certification

Another major public or governmental incentive that supports the concept of a private/public partnership in the Florida HSR Program is the certification process for approving plans and awarding the franchise. Any project of the magnitude of a 340 mile HSR system can have substantial positive effects on the environment, land use and economic growth in the areas through which it travels.

The Florida HSR Act has set up a very comprehensive and elaborate process to expedite compliance with various state, federal and local laws relating to these requirements. These certification procedures are a valuable asset to the private sector HSR builder because he will know up front exactly what information has to be supplied and when approvals will be given. At the time the HSR franchise is awarded, the franchisee will have completed all or most of the environmental and land use requirements including information required for any environmental assessment required by Federal or State agencies. The franchise award will be the official and final State certification or approval to build the system.

This Certification process starts with the Request For Proposals issued by the Commission on January 30, 1987. Other key dates in the franchise award process are:

Issue RFP	Jan 87
Initial Proposals	Mar 88
Evaluation and Selection	Jul 88-Oct 89
Franchise Award	Early 1991

SYSTEM TECHNOLOGY & OPERATIONS

The Florida HSR Act defines a high speed rail system as "capable of operating at a minimum of 120 mph". Thus, any business group or technology supplier, capable of financing, constructing and operating a system in accordance with the RFP can offer a proposal.

Several businesses and consortiums representing diverse technologies have participated in the Florida process over the past several years and are positioned to make serious proposals for the Florida Plan. These representative technologies include:

French TGV System
Bullet or Shinkansen Trains of the Japanese National Railroad
Mag lev System developed by JNR
Mag lev System developed by Japan Air Lines
German Transrapid Maglev technology
German developed Intercity Express (ICE) trains
Swedish trains
Magne Plane maglev systems

TABLE 2

Florida High Speed Rail Study

Alternative	Preconstruction Engineering ($)	Right-of-Way Acquisition ($)	Construction ($)	Operation and Maintenance ($)	Total ($)
120-16-8	182,634,000	297,443,000	1,306,337,000	431,230,000	2,217,644,000
160-16-5	208,971,000	297,443,000	1,578,693,000	454,924,000	2,540,031,000
160-16-8	208,971,000	297,443,000	1,601,912,000	454,924,000	2,563,250,000
250-16-8	378,246,000	297,443,000	3,050,127,000	591,604,000	4,317,420,000

Source: Florida High Speed Rail Study, Final Report
Barton-Aschman 1984

There do not appear to be any physical or institutional impediments to any of these systems being considered for the Florida project. The ability to finance capital costs and operations and maintenance costs however, will be critical factors in offering a viable plan. Table 2 illustrates the range of costs projected for each system, operating over the primary corridor and utilizing a combination of 8 or 16 train frequencies per day.

All of these estimates and projections of costs, revenues, ridership and other quantitative data will be analyzed by each proposing consortium to verify the applicability to the type of technology and operations being proposed.

Although any of these systems represent substantial investments and will require some unique and innovative financing, development opportunities and the vested development rights that will go with the franchise award could make this an attractive private sector investment. The participation of several business consortiums over the past several years is a good indication that Florida will probably be the location of the first new intercity high speed rail system in the U.S.

Conclusion

Florida is well on the way to implementing a high speed rail system. Success for this project depends on private sector interest which has been amply demonstrated. Success will also require support and cooperation from federal and state governments.

At the federal level agreement will have to be fashioned to permit use of highway corridors where needed and to accommodate new high speed rail technologies under the federal safety standards. Compliance with federal environmental requirements will have to be met. Bringing high speed rail technology and service to the U.S. should be of major interest to the federal government as a demonstration of net transportation technology and as an economic and foreign investment incentive. It will encourage foreign investments in this country and can set the stage for a major new form of intercity transportation in this country.

It is also estimated that a high speed rail system in Florida can substitute for future highway needs of 300 lane miles or $325 million over a 25 year period. The benefits of succeeding in this venture are significant and will accrue to all levels of government. We in Florida are succeeding with high speed rail.

Mr. Smith. Good morning, Mr. Chairman, members of the committee. I am presenting the statement on behalf of the Florida High-Speed Rail Transportation Commission and its chairman, Mr. David Blumberg.

When this hearing was first scheduled back in February, Mr. Blumberg was very much interested in being here personally, but due to an accident he could not be here and could not travel.

We are very pleased to have the opportunity, nevertheless, to comment on a transportation concept that will have significant and far-reaching benefits for Florida, and indeed the rest of the nation. And we congratulate this subcommittee for its farsighted interest in conducting a hearing on this matter here in Florida.

I have submitted a more extensive statement, so I will indeed summarize my remarks here.

Recently on the NBC Nightly News, John Chancellor commented on the state of rail transportation worldwide. His conclusion was that a measure of a civilized society is how well developed their train transportation system is. In making those comments, he was critical of the United States' status in world transportation. And there are several reasons.

We have had certainly an overdependence on the use of the automobile and, as you have already heard, our airways may be not operating up to par. However, we are fast reaching saturation points in developing new highways to serve our population growth and probably the same will become true with air transportation in the future.

The obvious solution for part of our future transportation need is to modernize and support our rail system. Florida, with its phenomenal growth rate, will be forced to deal with these issues sooner than many other states.

Between 1960 and 1980 the state's population doubled, from five to ten million people. This dramatic pace of increase shows no signs of abating, and indeed the population will again double between 1980 and the year 2020.

It is impossible to pave over enough land into roadways to provide mobility for this projected population increase. But in addition to the population increase, tourism, a mainstay of Florida's economy, will also continue to increase. Projections indicate 60 to 90 million tourists will visit Florida by the year 2000, compared with 45 million in 1984.

However, there is one means of transportation that will help unify and provide mobility for the state in the future. Throughout Europe and Japan, high-speed train travel is an integral part of the transportation network. The need for high-speed rail in Florida was demonstrated in a consultant study completed in 1984, which was conducted by the Florida Department of Transportation with the financial assistance of the Federal Railroad Administration.

In that study, potential daily high-speed ridership was projected at 54,000 passengers taking trips of less than 85 miles and 17,000 passengers taking trips in excess of 85 miles. On ridership alone, the market is there.

Our analysis has also projected over a 25-year period from 1995 to the year 2020, that tourism expenditures will increase by a factor of $26 billion, or a billion dollars a year, as a result of the high-speed rail system.

7,500 will be created as a result of the construction of the system and each year after the system is in operation there will be 1,500 jobs created in order to operate and maintain the system. These direct and related secondary economic activities alone create a strong economic argument for high-speed rail.

We have also estimated that over the same 25-year period 304 lane miles of freeway would not be necessary, given the capacity potential of high-speed rail. This could avoid highway construction costs of over $900 million.

High-speed rail technology varies, but the essential ingredient is high speed and safe train travel. The French TGV system between Paris and Lyon has been in service since '83, as you have heard, and has a very excellent safety record, as has the Japanese system.

There are also some new high tech systems under development in Japan and Germany and also in the U.S. These systems, as well, have a possibility of being considered, and are being considered for the high-speed rail system here in Florida.

The real effort to bring high-speed rail to Florida began in 1982 when the High-Speed Rail Committee was formed by Governor Graham in 1982. The work of this committee led to a clear and direct state policy of support through the High-Speed Rail Act of 1984 and the appointment of the High-Speed Rail Transportation Commission to implement that policy.

This commission, comprised of seven business leaders, has developed a request for proposals and has issued that proposal as of January 30th and plans to award the franchise and oversee the construction and operation of Florida's high-speed rail system.

The commission has devoted many hours to the project and has produced guidelines which allow maximum flexibility on the part of the prospective applicant and full consideration of state and local environmental and growth plans.

The project is patterned primarily as a private sector financed and operated project which will have a price tag of somewhere between two to five billion dollars, depending on the technology.

The corridors designated by the commission to be built initially will link Dade County with the Tampa Bay region, Hillsborough and Pinellas County. And that map over there on the board illustrates some of the potential routes that could be followed, given colocation with existing transportation facilities.

However, we emphasize to you that the actual route between these designated termini will be determined by the private sector franchisee. It will be a private market decision.

Currently the RFP has been issued and 13 firms have officially notified the commission of their intent to participate or apply for the franchise. The initial proposals are due by March 25th of next year, 1988, and we project with our schedule that the award of the franchise could occur in late 1990 or early 1991.

During that period of time, substantial review will be conducted by state agencies, local governments and environmental organizations about the process. The Federal Railroad Administration at the Federal level is the lead agency to assist with environmental review and related Federal and national issues.

Recently the international railroad journal, Railway Age, in an issue, pronounced Florida as setting the pace for high-speed rail in the nation. And as you have already heard, we hope that in 1995, on the 150th birthday of the State of Florida, we will see the beginning of high-speed rail.

Mr. Chairman, this hearing is another important step toward accomplishing our goals and will add greatly to the understanding of high-speed rail and the need for high-speed rail as a new and innovative mode of transportation.

We thank you very much for the opportunity to offer our comments and participate in this important meeting.

Mr. LEWIS. Thank you, Charlie. It is nice to have you both here.

Bill, I have not seen you in a while. You have to wear so many hats in your job.

Mr. MILLER. Yes, sir.

Mr. LEWIS. It is nice to have you with us.

I would like to say—and it is nice to be boastful on occasion—that Florida is leading the nation in high-speed rail. I would like to know—maybe, Bill, you can tell us, what are the factors that motivated Florida to move so aggressively in building a high-speed rail system?

Mr. MILLER. I guess there are two major features and that has to do with the fact that Florida's energy equation is really strung out as it relates to the consumption of hydrocarbon fuels, and the other feature is that our air space is becoming very, very congested.

Some of us who had the opportunity to work on I-95 in the 1960s and 1970s know how difficult that project was to accomplish and how difficult it is to add capacity to those alignments. So the question naturally came, is there another tool that can be used for these increased capacities that we must have, and is that tool a sound engineering and economical tool.

Just merely looking at it from an engineering viewpoint, it is rather clear that high-speed rail transportation is the tool for our state between the major population centers of 250,000 people or more.

So that simple equation is the feature that caused us to become interested as a state policy to invest in this business.

Mr. LEWIS. Charlie, I recall attending a hearing in Fort Lauderdale several months back. Are all the RFPs out now for technology for the proposed system?

Mr. SMITH. Yes, Congressman, we issued the RFP officially and advertised it in the Wall Street Journal on January 30th and that is the start date for all the time schedules and deadlines that are in this process going over the four-year period between now and 1991.

And as I mentioned, we have had a very fine response from the private sector, international organizations as well as domestic business companies, interested in building high-speed rail in Florida.

Mr. LEWIS. Do you think—does the commission feel there should be a larger Federal role involved in the high-speed rail program?

Mr. SMITH. Congressman, our commission has very consistently advocated that this should be a private sector responsibility.

We recognize there are some very important Federal responsibilities, as well. I think Mr. Riley has touched on some relating particularly to safety and, of course, helping us with the environmental rules.

As far as the funding is concerned, I think there are programs at the Federal level that could, in fact, contribute very importantly to this whole project, and those are programs that are already in place, for example, grade crossing projects or funding programs administered primarily through the state DOTs. That is a very important component, I think, of the financial viability of building the infrastructure eventually, to be able to utilize those.

And indeed there is a project here in South Florida, I-95 reconstruction, which will help to alleviate some of the grade crossings over the existing railroad line, which may become a corridor for high-speed rail.

So I think there is a very important Federal role, but we do not and have not recommended and have not sought a specific Federal involvement in the project.

Mr. LEWIS. Thank you.

Mr. McCurdy?

Mr. McCURDY. Thank you.

Mr. Miller, how much money do you estimate the State of Florida will have invested or will invest in the development of the technology and the system?

Mr. MILLER. Well, to this point in time we probably have invested in the form of cash somewhere between five and ten million dollars. We are negotiating a purchase with the CSX Railroad that will probably cost us about $275 million, and we believe that that particular corridor is going to be extremely necessary to get the high-speed rail apparatus into Miami.

But that corridor is going to require a heavy investment with respect to overpasses and underpasses, for not only rail transportation purposes but for highway purposes. We expect to spend half a billion dollars in that area of business, too.

So if you take just those figures into account, you can say that our planning and work programs anticipates approximately three-quarters of a billion dollars worth of activity that would lay toward this advantage.

We further feel from our analysis that other funds are going to be required, particularly as it relates to grade separation, and that amount of funds will depend upon which corridor the commission selects in the pursuit of this business. But it could be as much as another half a billion dollars.

So at an outside figure, you know, as much as a billion and a quarter, but not all of that is directly related to the business of high-speed rail. It will be for many different modes and submodes.

Mr. McCURDY. Well, certainly it is a major state investment and, not being from Florida but having witnessed transportation projects in a number of states, certainly you are to be commended for the foresight and planning that has gone into this.

Mr. Smith, this subcommittee—our subcommittee is most concerned about the technology and the development of new technologies and insuring that proper emphasis is being made on the development of new techniques, and I am interested in your decision-making process.

Will the commission—how will the commission make its decision on the technology itself, making the basic decision from steel on steel to other technologies, and who will you be relying on for the expertise?

Mr. **Smith**. Well, Mr. Chairman, we have a very elaborate——

Mr. **Lewis**. Mr. Smith, excuse me just a moment. Could you speak into that mike, please, so we do not miss any of these words for the record.

Mr. **Smith**. Mr. Chairman, the commission will operate on a very elaborate review and decision-making process, which is, as a matter of fact, incorporated in our High-Speed Rail Act, and then additionally elaborated by substantial rules that in the State of Florida we prepared. So we have a very precise process that we go through.

Now, how will we actually do the selection? I think there will be many factors. We will have to consider very carefully the financial feasibility and the financial viability of the system. We intend to award a franchise in the private sector and we expect that they will follow through and build that system, so we will be very careful that whoever appears to have the winning franchise or winning proposal will, in fact, be able to follow through, they will have the financial backing.

As far as the technology is concerned, I think clearly elements of safety and welfare of the traveling public are going to be uppermost in the minds of the commission. We will have to have a system that is absolutely fail-safe and we will expect the proposers to prove and to justify the safety of that system.

We would also be looking very carefully at the future operating and maintenance costs. We would not want a system that would become a drag either on the private sector that is building it, and certainly not—we are not looking to having the state or any public sector pick up the operating costs at some future time. I assure you of that.

Environment—a very important element in Florida. Any transportation system—and we think high-speed rail probably has the least potential impact on the environment, but some systems may have more than others and I think we will have to balance that against the other factors of safety, the other factors of financial viability.

Our statute has a very curious wording in it. It says that the commission will select the system—the most worthy system, and that gives us a lot of latitude to evaluate all the factors that will be available to us.

How will we do it? We will use, of course, our own expertise in our staff. We will use expertise that is available in other state agencies. We will look to consultants. We will look to some of our academic institutions who do have expertise in some of the very technical areas. And you will hear from people this morning on that subject.

We will build a review process involving experts from every area to help us evaluate various elements of this proposal and all of that information will be made available to our commission, to other committees that are established by state law, and ultimately the Governor and Cabinet in the State of Florida will also have a very important role in the final decision.

So we think we not only have a process in place, at least as far as the method is concerned, but we will also have one that will be very effective and will reach that right decision.

Mr. McCurdy. Very good, gentlemen. It sounds like a well thought out plan and certainly appears to reflect a high degree of professionalism, and I think that will be important to the success of your system.

I would like to also say, the former chairman of this full committee, Don Fuqua, was a mentor to many of us. I have been in Congress for seven years and I was one of the first members to seek selection to the Science Committee when actually it was not a very competitive committee. Not a lot of people were trying to get into it.

But now I am one of the eight appointees of the Speaker on the Steering Policy Committee which makes this selection to committees. And because of Don Fuqua's leadership, the Science and Tech Committee has become one of the most competitive and sought after committees in the Congress, and we have literally had to defer a lot of appointments to that, and you have a number of well qualified members on that committee. Mr. MacKay from Florida certainly, Mr. Nelson, a close friend and neighbor.

Again, I think you are well served and it appears that you have got a good plan.

Mr. Lewis. The gentleman from Wisconsin.

Mr. Sensenbrenner. Thank you very much, Mr. Chairman.

I would like to ask how confident you are of the economic feasibility study that started this thing off?

Mr. Smith. Our economic feasibility study was conducted in 1983 and was completed in 1984. It was done by a transportation consulting firm under contract to the Florida DOT and under their management prior to the formation of the commission, and funded by the Federal Railroad Administration.

I would have to concur with Mr. Riley's conclusion. I have been in the transportation field myself for a good number of years and I think that that study is a very excellent study. It reflects a great deal of conservatism in its projection of ridership, for example, and it states that. It says that they intend to be conservative throughout the work that they have done.

We are in the process ourselves—and I suspect that even some of the private companies that are developing proposals will further review and refine some of the economic projections, the ridership numbers. And, in fact, we would fully expect them to, over the course of the period that they are preparing their proposals.

Generally we have heard from other people who have reviewed the study that it is a thorough, it is a very professional, it is based on sound economic methodologies, analysis methodologies, and that its conclusions are well drawn.

I tend to agree with that and we are going to continue to examine every aspect of it. Indeed, we are in the process of doing that right now.

Mr. Sensenbrenner. Do you have any estimate of what the break-even point would be with the two million passengers a year that the appendix of your testimony indicates would probably go on the high-speed rail?

Mr. SMITH. The study and the numbers you are referring to indicated that a ridership of the two million three, I believe it is, for one of the technologies, could pay for the daily operating and maintenance expense of the system and part of the capital cost.

Now, a very important element there is that those figures, that ridership number, are very conservative. And if you look back into the report and study its techniques and its methodology, you will find that indeed the consultants said there is probably a lot more ridership out there, but we are not going to put this in our study and say that that is the basis for making this thing financially viable.

So, in effect, what they are using is conservative numbers and have come to the conclusion that, even with those conservative numbers, we can pay for all of the operating costs and part of the capital costs.

And, of course, a very important corollary to that is that in order to finance the remaining part of it, that is why our High-Speed Rail statute provides for the development rights opportunity, that is, to develop lands around stations to help finance the remaining part of it.

Mr. SENSENBRENNER. I was going to get to that next. I am somewhat familiar with this area, since my father has lived in Boca Raton since 1964, and I remember during the construction of I-95 close to the coast, every extra mile was greeted with a great sigh of relief that people did not have to go out and take the turnpike to go for even short- to medium-distance trips.

Now, it seems to me that with your ridership projections you are kind of caught between a rock and a hard place because the turnpike is referred to by most people as out in the Everglades and one has to dodge the alligators in order to get on it, and if you use the corridor along the turnpike, it seems to me that you have got a lot of land to develop there and I think that that is good, but there is going to be a downside in the lack of ridership from people who do not like to go 12 or 15 miles out to the turnpike to take the train.

On the other hand, if you use either—the CSX corridors along the coast, the development has taken place and this powerful economic tool that can fuel the payment of a lot of the capital construction costs simply is not there, but you get more riders.

Now, perhaps I have stated this inaccurately, as a foreigner who comes to Florida several times a year. But are you not kind of caught in an economic Catch 22?

What is your response to that?

Mr. SMITH. Well, I think you have defined a very important issue, and it is one that the private sector applicants are going to be facing, and that is the trade-off between building the high-speed rail on a route that runs through existing developed areas, where there is presumably current population and ridership, as opposed to running it in areas that do not have resident population at this point but rather relying on future development. And that is going to be a matter of evaluating which of those options these people consider to be the most beneficial to their particular plan.

But we recognize that that decision is going to have to be made, it is going to have to be made on the basis of the best economic projections that are there, and it will be on the basis of are you trying to satisfy a future population development area or are you trying to satisfy the one that exists here today.

Obviously also the availability of the route is very important. One of our objectives is to try and encourage the high-speed rail line to use existing transportation rights of way, whether it be turnpike or I-95 or CSX Railroad line, because we assume that it might do least damage to environment. Of course, it would probably be less costly if you use an existing right of way.

So all of those factors are going to enter in there, but you are absolutely right in terms of defining the issue, that is the question.

Mr. SENSENBRENNER. Now let me get back. My first question was what does your economic feasibility study say to that particular problem, having the line off to the west at the turnpike, which is relatively undeveloped but has a lot of potential development rights, rather than using either I-95 or the CSX route?

Mr. SMITH. The economic studies that were done were not specific to a route, they were not looking specifically, you know, at a route in that kind of context, but rather serving the South Florida corridor.

Those are refinements that obviously are going to have to be done and are going to have to be done very carefully. But that information is not yet refined to that point.

Mr. SENSENBRENNER. That is one of the main questions that I have to have as a representative of people in another part of the country, should there be a request for either planning money or construction money, if it ever comes before the Congress.

And to be very honest with you, I could not support an expenditure of Federal funds until the questions that I posed are answered. I hope that between now and the time the franchises are issued, that economic feasibility study will be brought up to date and it will become a little bit more specific.

Thank you.

Mr. LEWIS. Thank you, Mr. Sensenbrenner.

I want to thank both of you gentlemen for——

Any further questions, Mr. Chairman?

Mr. MCCURDY. No.

Mr. LEWIS. Coming from Florida, one thing I am sure that has a lasting impression on you, if we had a high-speed train, you would have been able to arrive faster than if you came by airline.

Mr. SMITH. You are absolutely right.

Mr. LEWIS. Our next witness is a member of our County Commission, Mr. Ken Adams. High speed rail in South Florida could not have gone this far without the leadership of many of our local governmental officials, and one of these leaders is with us today, Ken Adams, who may even be known sometimes as the stepfather of high-speed rail and is certainly one of the initiators of the Tri-County Train between here and Miami which makes a lot of the high-speed rail feasible because it eliminates all the inner-city connections and stations so you go from one major city to another and then intersect and pick up the high-speed trains.

Mr. Adams.

STATEMENT OF KENNETH ADAMS, COUNTY COMMISSIONER

Mr. Adams. Thank you very much, Mr. Chairman, and members of the committee. I am trying to see if I can find a portable microphone here that I might use for a moment.

Perhaps we can speak from here. I appreciate very much an opportunity to participate with you. I just came to listen primarily, but I appreciate an opportunity to share perhaps a local government's perspective of what we think high-speed rail might mean not only to Palm Beach County but to Southeast Florida.

What we are looking at here—I really wish I could walk around a bit—is a slice of Palm Beach County, this area in green with the arrow over to your right is where we are sitting now here in West Palm Beach, and we are just looking westward across the county. If we can try and envision that slice of Palm Beach County as a northern gateway to a very major metropolitan area from West Palm Beach to the City of Miami, roughly four million people a day, growing to roughly the population of Chicago by the time the high-speed rail system is in being.

We have many lines on there, and I will try and explain them from here. The orange line going east-west coming out of the area of West Palm Beach is a general corridor that we are looking at for an east-west expressway. It will be the first expressway east-west in Palm Beach County. We have about 100,000 trips a day through that corridor today, going to 200,000.

The green line over to your left represents—I know Congressman Lewis is very familiar with it—and that is a hopefully widened state route 80. This is significant because that is the first across the State of Florida road since you left Alligator Alley down in Broward, and you have to go two counties north of us to come to the next totally across-the-state road.

The criss-crossed yellow lines are Palm Beach International Airport. Congressman Lewis' opening comments were so apropos here in Palm Beach County because he talked about the restriction of air service. We are expanding that airport now, 188 million to go from—excuse me, to go from 12 gauge to 24. Before the high-speed rail is inaugurated, we will have gone from 24 to 44, and that will be the max for that airport, we will not be able to expand it any further than that. I chair a committee to try to locate just another airport location for just private aviation, and I am sure you realize it is a slow and agonizing process.

The orange portion there in the center, roughly the center, just to the left of the center, is a piece of property that we in Palm Beach County are putting together to make available for a high-speed rail station. It will be anywhere from 150 to 200 acres. We feel so strongly that high-speed rail is an essential part of our overall transportation network in Palm Beach County, we began making that commitment when we first learned of the high-speed rail plans.

The—over on your right going up the yellow line, which is I-95, is a very thin orange line going into the City of West Palm Beach. That is the tri-county commuter rail that we are so thankful for your support in the Federal Government. We have committed $100 million between Federal funds, state funds and local county funds, to create and operate that commuter rail over the next five years. That $100 million sounds like a lot of money, but one mile of 595 that is being east-west in Broward at the present time is costing $100 million. That is $100 million to create that rail system and operate it. It will be using the first doubledecker cars used in this country, they were purchased in Canada. Again, it will be serving at the present time about four million people. The significance I think, above and beyond just a commuter rail system, is we are designing our ingress and our egress at our airport where that commuter rail can come right in the airport and then be extended over to the high-speed rail station.

So if you have a high-speed rail station here and another one in Miami, you will have that commuter rail in pace serving it as a distributor and a collector for every major metropolitan area between West Palm Beach and Miami; Fort Lauderdale, Boca Raton, all of the cities. At the same time, we will have kiss and ride lots to the west in the residential areas with express buses running to it.

So, very briefly, we would require 44 lanes of I-95 according to our engineers to handle the north-south traffic through Broward. The Florida Department of Transportation in its wisdom is going to have I-95 torn up for not more than five years, perhaps as short as three years. In its wisdom, it is going to have every other north-south route through Broward County torn up at the same time. Our conservative estimate is it will be adding at least an hour minimum in driving time between West Palm Beach and Miami.

So from a local perspective, we are tremendously excited about the high-speed rail. We view it as not just another train station in Palm Beach County but an opportunity to design a transportation network that will complement itself for roughly 750,000 people at the present time, expected to double in the next 12 or 13 years. And for each person who is living here at the present time, there are about four tourists who come down in the winter months as well. So we feel it absolutely essential to service again roughly the population of Chicago, we are thinking in terms from that station to the Miami station, on the high-speed rail of 15 to 20 minutes. From there to Tampa-Orlando, 45 minutes to an hour, depending on which system is going to be put into place.

We are finding developers anxious to work with us, not only on that station but on the commuter rail station, making commitments for land and financial contributions towards the station. So there is a tremendous excitement in southeast Florida for this integral portion of what we feel is a badly needed transportation system.

Thank you, Mr. Chairman.

Mr. LEWIS. Thank you, Ken.

Do you have any questions?

Mr. McCURDY. I would just like to say that it is always interesting to see someone who does not come prepared for these meetings. He just happened to have his chart with him. I am glad you walk around with that. [Laughter.]

It appears you are concerned about the future, and with this type of explosive growth I can see why. It would be a nightmare for the average city manager or county commissioner, and I certainly see why you have to carry that with you.

Mr. LEWIS. Mr. Chairman, Ken, for so long has been instrumental in getting everything put together, it has died and he has resurrected it several times, and I guess at the drop of a hat I do not know whether he—I am sure he carries his equipment with him and is ready to speak. It is almost a second life to Ken.

Mr. ADAMS. Thank you very much, Mr. Chairman.

Mr. LEWIS. Our next panel is Mr. Sam Tabuchi, Director of JNR Mag-Lev Florida Office in Tallahassee and Robert Blanchette, President to the TGV Company in Washington, D.C. And what we would like to do, gentlemen, is let Mr. Blanchette speak first, he has to leave to catch an airplane. What we would like to do, Mr. Blanchette, is hear your presentation and have questions and then you are free to leave.

STATEMENTS OF ROBERT BLANCHETTE, PRESIDENT, THE TGV CO. WASHINGTON, DC; AND SAM TABUCHI, DIRECTOR, JNR MAG-LEV FLORIDA OFFICE, TALLAHASSEE, FL

Mr. BLANCHETTE. Thank you, Mr. Chairman.

Mr. LEWIS. We appreciate the time constraints you placed yourself under. Mr. Tabuchi, why don't you just come up as well.

Mr. BLANCHETTE. Thank you, Mr. Chairman, I appreciate your accommodation. After listening to the weather forecast on the Today Show, I can truly say that I am delighted to be here before this subcommittee, and I am leaving to participate in the Centennial of the Interstate Commerce Commission's Foundation. In view of certain positions taken in government about the Interstate Commerce Commission, it may be the last such occasion in the history of that august body, and I appreciate your accommodating my being able to attend it. I think there will be a Bicentennial of the Interstate Commerce Commission, however, although the chances of my being there are quite remote at this point.

I have my testimony and the appendices before the committee; and with your leave, if they can be incorporated in the record of these proceedings, I shall summarize them.

The first part of the statement deals with the TGV Company and what it is. And let me say that the TGV Company, while it is a promotional organization, is not the linchpin of the consortium that will build the high-speed rail system. It is merely a technology, and essentially the consortium that will build the system will be an American consortium, and the technology deals with approximately 12 percent of the entire worth of the project. So the technology is only there because, as Administrator Riley said, it is not worth the time, and it is not worth the investment to reinvent the wheel.

But there is a role for American know-how, and I will come to that in my testimony.

Obviously the timing and the venue of this hearing is most a propos since Florida will have the first high-speed rail system in the nation, followed on its heels, probably, by New York to Washington, and in the estimation of many, in Ohio.

I touch briefly on my own experience, being Mr. Riley's predecessor. I have a sense of deja vu over some of these issues, and I will incorporate his remarks about technology as to why we have to go abroad. It is not because in the French case we owe them one for Lafayette, but because they have a train that works, makes money and does everything that needs to be done, as does the Shinkansen, should that technology be operative.

I think, however, that in technology we ought to take it in context, and I do say on page three of my testimony that in choosing technology, we must be ever mindful of public need and perception. The finest technology in the world will not put people on a train if there is no need. You are never going to have a high-speed rail between Chicago and Los Angeles, save on NBC and Super Train.

On the other hand, a need for good rail service can be left unfulfilled because the technology is outdated. Now we know first-hand what that does in the northeast corridor. I happen, formerly as general counsel for the New Haven Railroad and then as a trustee of Penn Central, as an administrator of the FRA, have seen every possible ramification of that. The need has always been there; New York-to-Washington is the finest corridor in the world, bar none. It has everything that Tokyo and Osaka has, it has everything that Paris and Lyons has, and it has got Philadelphia in the middle. Yet the need went unfulfilled for decades because it was there with a World War II technology. It had a train that your grandfather could have gotten on.

Only with a modest improvement, still conventional technology, just a modest improvement going up at times to 125 miles an hour, that train just modestly improved, and last year surpassed in attendance all of its shuttle competitors. It took number one over the Eastern shuttle, which is otherwise known as man's inhumanity to man. And if it ever had a real train such as the TGV, it would probably end that humanity for all time and you could get from Washington to New York in a civilized manner.

In sum, technology and need go hand in hand. The role of technology is not to show off, it is to serve and encourage a need that exists. Because of our national love affair with the automobile, as well as our own dedication to excellence, only the best in rail technology will do.

Now we do know that left to pure public funding, there would be no high-speed corridor in this country. I believe that left to pure private resources, there would be no high-speed rail in this country. Where American know-how fits in is that happy ability to combine technology in the public sector and to make things happen. There is where Americans do that which no one else can do as well, we combine public and private resources in new ways. Nowhere in the world is that challenge more immediate and the promise more rewarding than in Florida.

The capabilities of the TGV system are set out at length in my testimony and in the exhibits and many members of this committee have already seen it. I hope that, Mr. McCurdy, you will have the opportunity to do so and to visit the other systems.

Let me talk a little bit about the issues in Florida. The need clearly exists in Florida. The Miami Herald carried a story last month which said that even when this concept of widening I-95 is done and finished, there still will be 50,000 cars more than the design capabilities of the system. As one state official noted, he is not cited in the Miami Herald, but I think you may have seen him recently in this room, even if we had 30 lanes out there, we wouldn't have enough.

So the most important issues for high-speed rail in Florida are intertwined with the larger issues of development and growth in this state.

Now the options for Florida are fairly simply stated and they are as contained upon that chart, and if you will turn—you have a smaller version of that before you, and let me just etch those options—I think that is a working microphone—if the members of the committee have the chart, if you will look at the map, the options are quite clear, between Miami and West Palm Beach there is no option. If the state acquires, as I believe it should, the right of way between West Palm Beach and Miami, that public investment will moot the point in that corridor. There is no one who is going to build a high-speed rail corridor in competition with the State of Florida and with the Federal Government to the extent that this becomes part of an interstate highway project.

I can tell you as a former railroad administrator and the trustee of the Penn Central that when the private sector tries to compete against the public treasury, the private sector goes bankrupt every time; witness the Penn Central, the Milwaukee, the Rock Island and many other railroads that we know tried to compete with trucks on a publicly supported right of way.

This, therefore, will be the corridor for every high-speed train, in my judgment. And it is not a bad corridor, if it is grade separated, as Mr. Miller said it will be, that corridor can be navigated at speeds of between 90 and 125 miles an hour easily and the speed can go—the time elapsed from West Palm Beach to Miami can be easily 15 minutes versus an hour and a half uncomfortable driving at present.

Then there are two essential options, one to utilize the CSX right of way which goes from West Palm Beach inland to Auburndale, where it makes a jog towards Orlando and then a jog towards Tampa. Another, which would serve the counties of Martin, St. Lucie, Indian River and Brevard and Mr. Lewis—I did not know he was going to be at this hearing when I put that in my testimony, but this coastal route, which essentially follows the Beeline and I-4, goes up toward Orlando and then would go down to Tampa. Those are the two lines. There are no really viable alternatives—alternate options. And the selection of those options is a mix of public/private questions. They are not questions which uniquely address themselves to the private sector or to the public sector.

And I enumerate some of them, and I think Mr. Sensenbrenner quite accurately portrayed the dilemma that there is there. Which corridor will serve the greatest number of people and alleviate congestion on the highways and in airports? Which will best meet the state's environmental concerns? Which will afford the greatest opportunity for balanced economic growth and prosperity? What are the safety considerations of each? What are the possibilities for real estate development, so-called "ancillary facilities" which will reduce the overall costs of the project, albeit not cross-subsidize it. How does each corridor affect the cost which the state will otherwise have to bear to build highways? There is at least a $900 million savings to the state if the corridors are built for high-speed rail.

Therefore, these are not uniquely private questions, they are not uniquely public questions. They are private/public questions which can only be addressed in concert. Only a private/public venture can bring into play the real estate development which exists and the discipline of private enterprise management. We have got to find that happy combination.

Let me give you a case in point which Mr. Miller referred to, and to which I highly subscribe. The question is one of safety. Grade crossings must be separated. Grade crossings are the natural enemy of high-speed rail. In France, for example, every grade crossing over 100 miles an hour is separated. In New York, when I was the Federal Railroad Administrator, we permitted the speed to go up to 120 and then to 125 miles an hour only after every grade crossing was separated. Similarly, between New York and my own home town of New Haven, Connecticut. They cannot go together.

It is inconceivable that one would, for example, build a public expressway and have it crossing at grade with a secondary road or a city street. It is the same logic that says it is inconceivable that one would build a high-speed rail system and have grade crossings. The two concepts are the same. They are public policy considerations, they are not railroad considerations. Very few locomotives have been known to leave the tracks in search of an automobile to hit. This is really a highway problem and a public safety problem, and I believe that Mr. Miller is absolutely correct when he says that that is something that ought to be borne as a public consideration because the train will go the same speed whether you have a grade crossing, a flashing gate, or a grade separation.

The question is the safety and convenience of the traveling public, both on the railroad and on the public system. We will never be in the 20th Century if we do not have grade-separated crossings. We will never have truly high speed if we have the bell and the whistle that our great-grandfathers used to know.

The role of the Federal Government was addressed by various members of the committee, and I think that is a very telling point. I subscribe to the view, having served in the administration for two years, that there are no Federal funds that should be or will be forthcoming for subsidies in operation or for the cost of infrastructure, save as grade crossing separation may become part of an Interstate Highway project. But I think that the thing ought to pay for itself, just as I believe, for example, that Amtrak between New York and Washington should and can be made to pay for itself.

It does not mean that the Federal Government should be indifferent to these considerations, and let me give you one example. The original High Speed Rail Commission Act, which I was fortunate to be one of the parties that helped in the drafting thereof, had as its underpinning that there would be tax relief for the bonds issues in support of the rail project, the infrastructure. At that time that savings of interest meant the difference between viability and non-viability. With interest rates around seven percent, that difference is about 200 basis points. We saw just a little burp this week when the Citibank and some of the other banks raised their interest rates. I do not know what they are going to be for the next 10 or 15 years, but they are going to be sufficient that the feasibility of the projects I think depends on tax relief in the sense of the bonds qualifying for some form of taxable relief, as was originally contemplated in the act. The particular way in which that will be done I do not presume to offer up to this committee, but that is a way, without breaking the precedent of the Tax Reform Act of 1986, that the Federal Government can look with favor on the private/public undertaking that is being envisaged here.

Florida has the unique opportunity to break with precedent. Everywhere else that we have gone, especially in the northeast where I come from, the way to do it has been to let the situation become totally intolerable and then to cement over it. Florida has the opportunity not to pave over all its problems but to break new ground, literally, and to be a showcase for the nation.

Thank you very much.

Mr. McCurdy. Thank you, Mr. Blanchette.

I want to ask one question, and I know you are pressed for time.

Mr. Blanchette. That is all right.

Mr. McCurdy. That is as to the technology. Could you explain generally what basic technology you are proposing and is there a—are you going to take this opportunity to present something different, as opposed to the trains that are currently operating in France, or is it basically the same technology?

Mr. Blanchette. I appreciate that question.

There are three technologies that we can think of. One is the conventional train that we all know that Amtrak uses and that probably led to the demise of passenger service in the United States, along with other factors.

Then there is the high-speed steel wheel/steel rail system which is still the most efficient way of conveying large numbers of people. The inherent dynamics of steel wheel/steel rail has survived decades of bureaucratic regulation, laws favoring other modes, and it is amazing that it still exists because it is just so efficient.

There are two technologies there essentially. One is the Shinkansen train, which has been in operation since 1964, and it is being, I understand, upgraded. I have taken the train. It is a first-rate train.

Sort of a second generation of that steel wheel/steel rail technology was the French TGV, which operates now at high speed between Paris and Lyon and then goes down to conventional speed, 125 miles an hour, throughout France and into Switzerland.

That train is the Model A of the second generation high-speed rail. It holds a speed record of 236 miles an hour. It has been improved so that the engineering is quite changed. The new model, which is called the TGV Atlantique, will operate in 1989 at 185 miles an hour. It is a state of the art technology with microprocessor-controlled suspension system, and no better train in the world exists.

A third technology has been spoken of and that is magnetic levitation. I forget—I am eliminating all of the exotic hardware that we played with in the '60s and '70s and the scraps of which can be seen at our test center at Pueblo, Colorado.

The magnetic levitation which is in the research and development stage may someday become a viable technology. It cannot be made operational in time, in my judgment, for this project, if this project is on the timetable that Charlie Smith set out. It will ultimately work.

I think in the United States if we are to have a public/private venture and we want to attract private investment, which I think we should—the bankers have cold and steely hearts, they do not want to invest in research and development. They want to be able to buy a ticket, take a train, ride it, get off and call back home and say the thing is there. Investment bankers do not loan money on either nostalgia or dreams.

So I think we are driven by that fact, if we want to attract private investment, to have something that already runs that you can take.

I have seen the turbo train built by Pratt Whitney Aircraft founder on the New Haven Railroad in the 1960s because it was not ready. It was an R&D project. I saw the original metroliners help the Penn Central fall into bankruptcy because it was not ready. It was a research and development project. I have seen all of the research and development projects attempted to be put into commercial service before they were ready. That is not the way to go.

The JNR tested the Shinkansen for years and years and years before it was put into service. The TGV, the testing started in the late '50s and it was evolved and evolved and evolved.

Millions of miles are put on these trains before they are put into service, and then they are put into service. And if we want to build something that is abroad, we ought to have something that works there. We do not want to be the guinea pigs for foreign research and development.

Mr. McCurdy. Interesting perspective. Thank you, Mr. Blanchette.

Mr. Lewis. Thank you.

The gentleman from Wisconsin.

Mr. Sensenbrenner. Thank you very much.

I would just like to ask Mr. Blanchette what the tax bill has got on financing these programs through the private sector.

Mr. Blanchette. The 1984 Act of the Florida legislature assumed that the bonds that would be issued—that could be issued to support the cost of infrastructure would qualify for tax-exempt status.

The 1984 Tax Reform Act took that assumption away and there is no longer the possibility that the state law and the Federal law can be brought into harmony unless the state were to actually itself build and issue the bonds. That may be a question that Governor Martinez and the state legislature wish to address.

But the original assumption of the Act has been dispelled by the Tax Reform Act, so that now were these bonds to be issued—the bonds, in my judgment, should be issued—they would not qualify for tax-exempt status.

Mr. Sensenbrenner. How much more interest are we talking about?

Mr. Blanchette. You are talking about at the present level of interest, where you are talking about a seven and a seven and a half prime, 200 basis points. Over the life of a 30-year project, that is in the scores of millions of dollars.

If our interest rates climb to anything near where they were a decade ago, the project does not become viable. I am not wishing that solution, but I think that the tax-exempt status——

Mr. SENSENBRENNER. Now, it is my understanding that the economic feasibility study that the two previous witnesses discussed was made before the change in the Federal tax law.

Mr. BLANCHETTE. It was indeed.

Mr. SENSENBRENNER. That eliminated the tax exemption for these bonds.

Mr. BLANCHETTE. It was indeed.

Mr. SENSENBRENNER. And so we have got another imponderable about where the break-even point is.

Mr. BLANCHETTE. No, it is not, Mr. Sensenbrenner. It is not an imponderable because it can be quantified.

Now, the Barton-Ashman was indifferent to tax considerations, by and large. It really did not speak to questions such as investment tax credit, accelerated depreciation and tax exemption on the bonds.

I am not even going to refer to investment tax credit or accelerated depreciation because I do not think that there is the slightest chance that anything could be carved out for high-speed rail for the State of Florida or anybody else, so that is forgotten and that is tens of millions of dollars. But that is the way the cookie crumbles.

Mr. SENSENBRENNER. You have just to realize you were addressing three members of Congress who had the courage to vote against the tax bill last year.

Mr. BLANCHETTE. Well, I know that, and I was going to say that I understand there was a tax bill and I knew that it took place in 1986. I have yet to see the part of it that is characterized as reform.

But at least as far as goring my ox for this client, this project has been knocked into a cocked hat by virtue of that, and certainly you would not want to have it subject to the state cap limitation because you do not want high-speed rail competing with all the other worthwhile projects in Florida.

Mr. SENSENBRENNER. That would take away everything under the cap. There would not be anything for anything else.

Mr. BLANCHETTE. Well, that is absolutely right.

Now, there was an exemption made for port facilities and airport facilities in Florida, and I think without doing violence to the spirit or intent of the Tax Reform Act, some measure of relief can be found.

The State of Florida should not have to walk it alone in that regard, especially since it is going to bring to bear something that no other project of this nature has ever brought to bear, namely, it is going to garner private sector resources, it is going to force the developers to contribute to the project.

And we all know, those of us who labor in Washington—I know that one of the concepts of this original bill in the state legislature came to me when I was commuting from Bethesda, Maryland, and I see that all the people in the United States contributed to this great hole in the ground that is known as the Washington Metro System.

When we come out of the hole, a lot of people are making money on hotels and office buildings in Bethesda and Rockville and the outlying areas, and it seems to me the genius of the Florida Act is to say, well, you could make money, fellows, but you are going to have to contribute to the infrastructure, so that I think it is a happy trinity of forces, the state, the private sector and the Federal Government. That confluence of events can bring this project into reality. Absent one of those three legs of the stool, I am afraid the stool will have the unhappy result that a two-legged stool has.

Mr. **SENSENBRENNER**. Thank you.

Mr. **LEWIS**. Mr. Blanchette, since you have a plane to catch, I think we will defer any further questions to writing and ask you to respond.

Mr. **BLANCHETTE**. I would be pleased to do so. I appreciate your accommodation.

Mr. **LEWIS**. Thank you for making the effort to come here and testify before us today.

Mr. **BLANCHETTE**. Thank you very much.

[The prepared statement of Robert Blanchette follows:]

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

STATEMENT OF ROBERT W. BLANCHETTE
PRESIDENT OF THE TGV COMPANY
BEFORE THE
SUBCOMMITTEE ON TRANSPORTATION,
AVIATION AND MATERIALS
HEARING ON HIGH SPEED RAIL TECHNOLOGY
WEST PALM BEACH, APRIL 3, 1987

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to once again appear before this Subcommittee and to address the two topics you have asked me to address:

1. the capabilities of the TGV technology destined for service in Florida;
2. the long term issues of the development of a high speed rail line in Florida and any technological limitations.

By way of introduction, let me describe The TGV Company and its mission. Formed in mid-1983, The TGV Company represents the French conglomerate, Alsthom, S.A., which manufactures the TGV (Très Grande Vitesse -- Very High Speed), the state of the art passenger train now in service in France and Switzerland. Our mission is to promote TGV technology in North America, working to the maximum extent with American partners. With the exception of the San Diego - Los Angeles corridor, we have been actively involved in all the potential corridors in the United States. I have represented The TGV Company since its formation, having served previously as Federal Railroad Adminstrator between 1981 and 1983.

This hearing is appropriately set and appropriately timed. Florida is generally considered to be the most far advanced in bringing a truly high speed ground transportation system into reality. Further, actions taken this year by Governor Martinez and the Florida Legislature can ensure that high speed rail in America crosses the threshold from dream to fact. If this is done, the transportation infrastructure of the State can be harmonized with its growth patterns, guaranteeing for Florida that long sought-for compatibility between the needs of its environment and the prosperity of its citizens.

In 25 years of experience in the railroad industry, I have witnessed at close hand the evolution of our national interest in new passenger rail technology. Beginning as General Counsel of the New Haven Railroad in the early 60's, then as Trustee of the Penn Central, FRA Adminstrator, and first Chairman of the American High Speed Rail Association, I have been exposed to all the technological efforts in this area, from Turbotrain to tilt trains, from Metroliners to Maglev, and from schemes which never left the drawing boards to the microprocessor-controlled TGV Atlantique now being built.

During this time, we have learned some valuable lessons about technology. A brief recitation of them here will serve to set the context for the Florida analysis. First, while we have the know-how to develop an American-designed-and-manufactured high speed train, there is not a sufficient market in this country to justify private sector research and development. In a Gramm-Rudman-Hollings era, a Federal R&D program is out of the question and, judging from past efforts, deservedly so. As a result, we must choose technology in use elsewhere in the world.

In choosing technology, we must be ever mindful of public need and perception. The finest technology in the world will not put people on a train if there is no need; for example, no surface transportation system will ever compete with the airlines between, say, Chicago and Miami. On the other hand, a need for good rail service can be left unfulfilled because the technology is out-dated. The corridor between New York and Washington is a good example. That corridor may offer the greatest potential for high speed rail in the world, yet patronage languished for years because the public perceived the technology to be out-dated. With only modest improvements permitting speeds in various segments up to 125 m.p.h., Amtrak last year moved ahead of its air shuttle competitors. In the opinion of many, a true high speed system would attract sufficient demand to generate investor interest from the private sector. In sum, technology and need go hand in hand; the role of technology is to serve and encourage a need that exists. Because of our national love affair with the automobile as well as our dedication to excellence, only the best in rail technology will do.

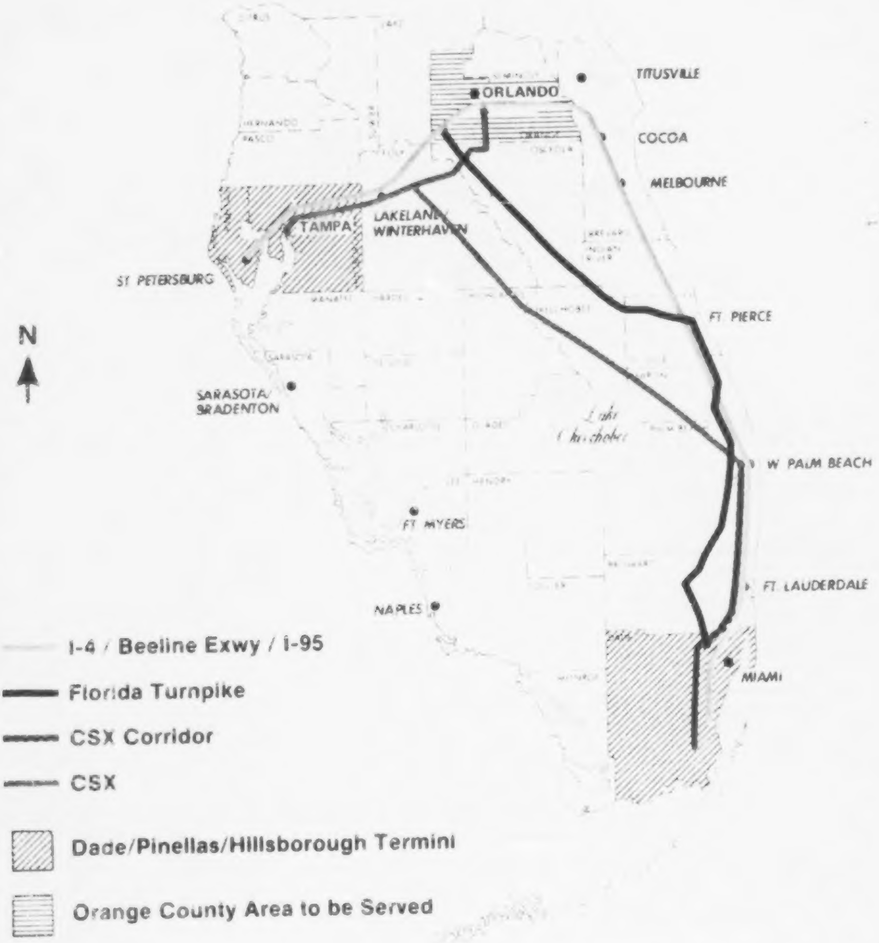
Left to pure public funding, as is the case elsewhere in the world, high speed rail may never develop in this country, regardless of need. Conversely, the magnitude of these projects is such as to put them beyond the reach of solely private resources. Where American know-how does fit in is in our ability to match technology and need to combine public and private resources in new ways, and to make things happen. Nowhere in the world is the challenge more immediate and the promise more rewarding than in Florida.

1. The Capabilities of the TGV system. In order to help you in your evaluation of high speed rail technology for the state of Florida, I have enclosed as an appendix to this statement various technical descriptions of the TGV, summaries of results of the current operation of the TGV between Paris and Lyon, and a description of the current expansion of the TGV system. If you have more detailed questions about these matters we should be most pleased to answer them. In summary, the TGV is the world's most technically advanced train, it holds the world speed record of 236 miles per hour, and it has operated with safety, comfort, and financial success between Paris and Lyon for five years. The second-generation TGV (the "TGV Atlantique") will run at 185 m.p.h. in revenue service in 1989. The TGV is the finest train in the world, and, because it is being constantly improved, will remain so. No need exists which it cannot serve better than all competitors.

2. Issues in Developing High Speed Rail in Florida. There is no need to guess at the need for improved transportation infrastructure in Florida. As the Miami Herald reported

FLORIDA HIGH SPEED RAIL TRANSPORTATION COMMISSION

POTENTIAL HIGH SPEED RAIL CORRIDORS


TITUSVILLE
ORLANDO
COCOA
MELBOURNE
TAMPA
LAKELAND/
WINTERHAVEN
ST PETERSBURG
N
FT PIERCE
SARASOTA/
BRADENTON
Lake
Okeechobee
W PALM BEACH
FT MYERS
FT LAUDERDALE
NAPLES
MIAMI
HERNANDO
PASCO
I-4 / Beeline Exwy / I-95
Florida Turnpike
CSX Corridor
CSX
Dade/Pinellas/Hillsborough Termini
Orange County Area to be Served

recently, for example, Interstate 95 will be 30,000 cars over design capacity by the time the present project to widen it between North Dade and South Palm Beach is finished in five years. As the state official noted: "Even if we had 30 lanes out there, we wouldn't have enough..." (Miami Herald, "Traffic worries on I-95 to run to year 2000," Feb. 26, 1987.)

The most important issues for high speed rail in Florida are intertwined with the larger issues of development and growth in Florida. The location of the high speed rail line and how much it improves transportation between different parts of the state will influence the direction and rate of growth in the state. The ability of the high speed rail line to accomodate growth in traffic and to foster cost-efficient transit will have a significant impact on the cost of infrastructure development to the state.

The best place to start with these questions of development, transportation, and cost is with a review of the options available for high speed rail development. The map on page 6 shows two corridors which represent the major alternative locations for the high speed rail line.

The green line represents the existing CSX rail line (which is sometimes referred to as the Seaboard Coast Line). The blue line shows I-95, the Beeline, and I-4, in whose general vicinity a new alignment could be built. The red line shows the Florida Turnpike for reference.

Between Miami and West Palm Beach there is only one real alternative -- that of the CSX which is highlighted with black dots. While other new corridors conceivably could be developed along the Turnpike or at the edge of the Everglades, if the State of Florida purchases this corridor from CSX and makes it available for mixed transportation uses, including high speed rail service, it will become the only corridor. In particular, if the State separates the grade crossings on this corridor, it becomes ideally suited for high speed rail service. The TGV can operate over this line in less than 50 minutes, compared to an hour and a half driving today.

North of West Palm Beach, the CSX runs to Auburndale and Orlando on an inland alignment. The solid blue line to the east shows the alternative "coastal" alignment passing through Martin, St. Lucie, Indian River, and Brevard counties, before turning west to Orange County and Orlando. Finally, between Orlando and Tampa there is the CSX marked in green, and a new alignment shown in blue roughly paralleling I-4.

There are advantages and disadvantages to each segment north of West Palm Beach and between Orlando and Tampa. The ultimate choice involves a mix of considerations. Which corridor will serve the greatest number of people and alleviate congestion on the highways and at airports? Which will best meet the State's environmental concerns? Which will afford the greatest opportunity for balanced economic growth and prosperity? What are the safety considerations of each? Where are the best possibilities for real estate development, the "ancillary facilities" which will reduce the overall costs of the project? How does each corridor affect the cost which the State will inevitably bear in terms of public highways to accommodate future growth?

While these questions comprise a partial list at best, they reveal a unique fact. The scope of the project has such public policy ramifications as to transcend the private interests involved. At the same time, only a private-public venture can bring into play the real estate development which exists. The challenge for the State and for those interested in the project is to arrive at the best accommodation between private and public initiatives.

Safety affords a good example. Crossings at grade are simply not compatible with high speed rail operations. In France, all road and rail crossings on the high speed line between Paris and Lyon are grade-separated. Here in this country, there are very few grade crossings once speeds rise higher than 79 m.p.h., and because of Federal funding over the last ten years there are none on the Northeast Corridor from Washington, to New York and New Haven, where speeds up to 125 miles per hour are permitted by Federal regulation. (Even at lower speeds, Federal funds have been available to assist the states in eliminating hazardous crossings.)

The elimination of grade crossings is in the end a matter of safety -- a railroad cannot operate any faster just because there are no grade crossings, but its passengers and the vehicles using the public road system are much safer with the road and rail conflict eliminated. The need to separate road and rail traffic is thus a public policy issue, not one that should be subject to analysis of the profit and loss statement. Just as public funds are used to separate expressways and secondary roads, the elimination of grade crossings on high speed lines should be a public undertaking. This is true regardless of the rail corridor selected.

It is too early to tell which of the two alignments would ultimately be more feasible for the private developer of high speed rail -- the CSX line with the property already assembled, or the coastal route with its own set of advantages and disadvantages. However, the state, and various counties and municipalities probably have clear ideas as to which alignment would be best for the public interest. I hope that in the next few months a consensus could emerge among public entities on which alignment is preferable and on the respective roles that can be played by the private and public sectors.

Permit me to return to a point I made the last time I testified before your subcommittee. There is a critical role that the Federal government could play in making this project a reality, above and beyond the encouragement and moral support given to date. Until the passage of the Tax Reform Act of 1986, the predicate of most financing plans was that revenue bonds would be issued to assist in the construction of the high speed rail line. It was assumed, because it was permissible at that time, that the interest on the bonds would be exempt from Federal income taxation. The Tax Reform Act has eliminated this possibility and has significantly increased the cost of borrowing. This has made it much more difficult to finance the private side of this private/public project. It would be most useful if a mechanism or new financing structure could be devised that would permit favorable Federal tax treatment without violating the intent of Congress in passing the Act.

Florida has the unique opportunity to break with precedent. Elsewhere, the conventional solution has too often been to wait until the problem became intolerable and then literally to pave over it. The proposed acquisition of the Miami-West Palm Beach right-of-way shows that the State is willing to entertain innovation. As the State breaks new ground, the technology will be there.

I should be pleased to answer any questions the Subcommittee may have.

Mr. LEWIS. I would like to call Dr. Kolm to come up and also testify on the panel with Mr. Tabuchi. Primarily Dr. Kolm—a lot of people here have been hearing about MagLev and do not know what it is. This would lead into Mr. Tabuchi's testimony, and I understand you have a demonstration to show. I think the TV cameras would like to catch that demonstration, as well. So why do you not tell us about your demonstration, what MagLev is.

STATEMENTS OF DR. HENRY KOLM, ALL AMERICAN MAGNEPLANE, INC., NEW PORT RICHEY, FL; AND SAM TABUCHI, DIRECTOR, JNR MAGLEV FLORIDA OFFICE, TALLAHASSEE, FL

Mr. KOLM. Mr. Lewis, I will get to that. I have only four important points to make. The first one—and it is all down in the testimony, but the first point I would like to make is that trains, as we know them, are basically 19th Century technology pushed to its limit.

Trains carry concentrated loads of passengers, a thousand passengers once or twice an hour. This means that they carry an enormous dead weight just to concentrate the load. The dead weight has to be distributed over the ground by crossties and gravel, and whenever a train has to negotiate a grade crossing or a tunnel, it means an enormous cost to carry that concentrated load. Between loads, the whole system stands idle.

A railroad has a 60 megawatt wayside power requirement which is used twice an hour. Railroads were invented 200 years ago and they have served a very valuable purpose in opening the West and all over the world, but it is time to consider that we are not building another generation of airliners which will be obsolete in ten years. We are building a transportation system which will have to take the world through the next century. And so we should consider that.

When I talk about MagLev, I mean the MagnePlane concept which was invented in this country, not abroad, in the late '60s and early '70s. And it is the first really new concept which differs from the basic concept of railroads.

It addresses the needs of today in that it carries people continuously in small packages and it has such enormous advantages over the conventional railway that it is inevitable.

And by this I mean it is as inevitable as the wheel and the wing. It will come, whether we do it here or not. It is the way people are going to travel when mass transportation systems of the present are saturated.

MagnePlanes travel several inches above an aluminum sheet trough with their weight distributed almost uniformly over the whole trough, and this is such a natural way of traveling that I would like to take leave to demonstrate this.

It is not an exotic, high technology thing. If you make a vehicle travel 200 miles an hour, it will float anyway. This aluminum disk which does not interact with the magnet— and this is a vehicle with a magnet on the underside—as the aluminum moves—and the aluminum here is moving only about 70 miles an hour—the magnet floats. It is that simple.

It is stable. It has a restoring force which increases as contact is approached. It requires absolutely nothing but the magnetic field and the motion.

This is exactly the same thing as aerodynamic lift. It produces lift at the expense of drag through the motion. This is what we are proposing as a mechanism for supporting a vehicle so they can travel. You are free to play with it after the meeting. This is no magic show. This is the simplest possible demonstration of what magnetic levitation is all about.

In other words, we are talking about something which I really call guided flight, in the sense that it is not rail, it is flight.

To summarize the basic differences between MagLev and trains, a train is a heavy device that carries a thousand passengers. A MagnePlane is a light fuselage that carries a hundred passengers instead of a thousand.

Instead of ten-stop trips, a MagnePlane makes non-stop trips. It can serve small towns because it can loop off the guideway.

In a train, cars are hard coupled and travel together. In a MagnePlane they are electronically coupled and travel individually and are routed individually. For this reason MagnePlane can serve many small towns. It is a capillary, rather than an arterial system.

A train is loaded and unloaded on line, which limits the headway. MagnePlanes are always loaded and unloaded off line, so that the main track is not obstructed.

Trains travel 100 miles an hour plus a little. MagnePlanes can travel 200 plus.

Instead of 60 megawatts of wayside power, MagnePlane uses 6 megawatts, and instead of using 60 megawatts twice an hour, it uses 6 megawatts once or twice a minute.

Instead of high-pressure tracks which convey steel wheels of many thousands of psi, MagnePlane is carried by less than ten psi.

Instead of a fixed bank which limits—inherently limits speed, the MagnePlane is self-banking. It can therefore negotiate grades and curves that a train can never negotiate.

The only noise a MagnePlane makes is the rush of the air.

The vehicles are passive, in other words, unpowered and controlled centrally. They are not controlled by a human operator who is susceptible to human error.

And instead of taking a 25-foot-square tunnel per track, MagnePlane requires only a 14-foot-diameter circular tube.

So that, in a nutshell, characterizes the kind of transportation we are talking about. I might mention, one more peculiar thing is the fact that the electromagnetic drag of a magnetically suspended vehicle actually decreases with velocity, so that you are spending less energy the faster you go.

The details of how this system works is described in not only the testimony which we handed out, but several articles which we appended.

MagnePlane, as I mentioned, was initially invented in 1969 and it was developed with support from the National Science Foundation and industrial contributions from several corporations, Raytheon, Avco, Alcoa and 3M, just to mention a few, over a period of five years until support was terminated by action of the Office of

Management and Budget in February 1975. At that time it was mothballed.

It was developed to the point of a fully operational scale model prototype which was demonstrated and appeared on a number of television shows, including Nova, and some of you may have seen it.

We have today put together a new team which comprises a Florida corporation called All American MagnePlane, which is headed by David Ramsey, a civil engineer who has been active in Florida for 14 years in land development, and a company which was formed from my original team that came out of the Massachusetts Institute of Technology and was set up as Electromagnetic Launch Research.

We are building, for example, the first electromagnetic catapult for the U.S. Navy and the first electromagnetic anti-tank weapons systems, and this little company—which operates, incidentally, in one of the earliest aircraft factories in this country—has been acquired by the Command Corporation, which is a 5000-employee company located all over the United States, including operations in Florida. We make parts for the C-5P bomber, for instance, at the Jacksonville Airport Facility of Command.

So EML Research has behind it the support of one of the most advanced technological teams in the world. We are prepared to make this technology work on time, on schedule.

Thank you for the opportunity to say something in behalf of 2lst Century technology, now having heard something on behalf of 18th Century technology.

Mr. Lewis. Thank you.

[The prepared statement of Henry Kolm follows:]

All American MagnePlane is pleased to have the opportunity to explain to the Subcommittee, AMERICA'S entry into the field of magnetic levitation in High Speed Transportation.

We do not like to refer to High Speed Rail as "Bullet Train" or "Mag Lev". MagnePlane means a passive vehicle along a magnetic wave like a surf board above a semi-circular trough, levitated several inches and propelled by a multi-phase alternating current. The vehicle is free to roll in the guideway trough so it can assume a coordinated bank angle when negotiating curves. In 1972 at MIT Dr. Henry H. Kolm and Dr. Richard Thornton developed a research project to demonstrate Electromagnetic Flight with the cooperation and financial assistance from Massachusetts Institute of Technology, the AVCO Systems Division, Raytheon Equipment Division, Minnesota Mining and Manufacturing Company and the Aluminum Company of America. During that research three (3) patents were developed by Drs. Kolm and Thornton with cooperation from MIT. All American MagnePlane has an agreement with MIT, Dr. Kolm and Thornton to develop the technology into a modern High Speed Transportation System to serve the State of Florida.

I am a Professional Engineer experienced in Civil Engineering and Land Development, however, the most important part of this hearing today is the new technology that is to be advocated for the Florida High Speed Rail Franchise. Here today to explain the MagnePlane Technology is Dr. Henry H. Kolm of Electromagnetic Launch Research Inc., a division of Kaman Aerospace Technologies.

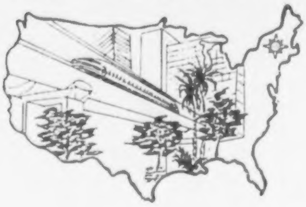
Dr. Kolm has 34 years of professional experience and has been a faculty member of the Massachusetts Institue of Technology, Senior Scientist of the Francis Bitter National Magnet Laboratory, and Lecturer in the Department of Aeronautics and Astronautics. Dr. Kolm is one of the founders of the MIT Francis Bitter National Magnet Laboratory, a center for high field research and expertise in magnet design, energy storage and high current technology, and one of the founders of Sala Magnetics Inc., manufacturer of high gradient magnetic separation and filtration equipment. Dr. Kolm's career has centered on the generation of very intense magnetic fields and their use for research and industrial applications. He has been an active innovator and industrialist, and was named "entrepreneur of the year for 1981" by Money Magazine. Dr. Kolm has published about sixty papers including three Scientific American Articles and has about forty patents.

MAY I PRESENT DR. HENRY H. KOLM.

In our presentation today we have concentrated on the technology since the MagnePlane is a relatively new field of transportation. The land development activities that are a part of the Florida Franchise Proposal are just as important since land development will be the method of paying for the capital cost that is necessary to build a MagnnePlane in Florida and elsewhere. We are on the leading edge of new technology that is capable of launching a shuttle craft into orbit without the use of chemical explosion. Thank you for the opportunity to be here today and if Dr. Kolm and I can answer any of your questions please feel free to ask.

All American MagnePlane, inc.

"american ingenuity" - "american technology"



address reply to:
5183 Seven Springs Blvd.
New Port Richey, Fl 33552
813 372-8036

THE ALL AMERICAN MAGNEPLANE: MAGLEV TRANSPORTATION

The MAGNEPLANE will be a high speed ground transportation system from Miami to the Tampa Bay area with intermediate stations at Ft. Lauderdale, West Palm Beach, Ft. Pierce, Kennedy Space Center, Orlando, Disney World, Lakeland and Tampa, using existing transportation corridors with alignment and grade control by an elevated guideway.

The MAGNEPLANE is not a railroad in which magnet pads simply replace wheels, but a radically new transportation system conceived to make full use of the advantages offered by electromagnetic levitation. The MAGNEPLANE resembles the fuselage of a medium sized airliner, provided with superconducting coils, and is suspended by eddy current repulsion about one foot above a cylindrical trough-shaped aluminum guideway, which surrounds the lower third of the vehicle's body. The top of the guideway will be enveloped with a clear plastic type material to provide security and other amenities. The MAGNEPLANE is free to roll in the guideway trough so it can assume a coordinated bank angle when negotiating curves.

The MAGNEPLANE is propelled by a traveling magnetic field generated by current loops which form an internal part of the guideway. The MAGNEPLANE rides upon this wave like a surfboard.

The MAGNEPLANE has a number of retractable wheels, which engage the reinforced edges of the guideway trough, distribute the vehicle's weight over its entire length of the guideway while it is stationary or traveling below its levitation velocity of 40 mph. These wheels can be used to negotiate ramps which lift the vehicle out of the guideway and into an overhead station.

The guideway is laminated trough of aluminum and fiberglass surrounding about one-third of the vehicle's body. It weighs about as much as medium duty rails (100 lbs/ft.) with all of the structure serving both mechanical and electrical functions. The elevated guideway structure will be high quality finished concrete with the top portion covered with clear plastic type material which will provide the accessibility of near vacuum conditions for reduced friction and wind resistance.

"breakthru in transportation for a better tomorrow"

THE ALL AMERICAN MAGNEPLANE: MAGLEV TRANSPORTATION

The guideway is divided into electrically independent blocks. The optimum lies between 2 and 5 miles. The power unit for each block contains two or more cycloconverters which are capable of supplying the east-bound and west-bound sections of the block with current of continuously variable frequency, amplitude and phase. This current is controlled by signals transmitted from the vehicle to provide synchronous acceleration, deceleration or cruise.

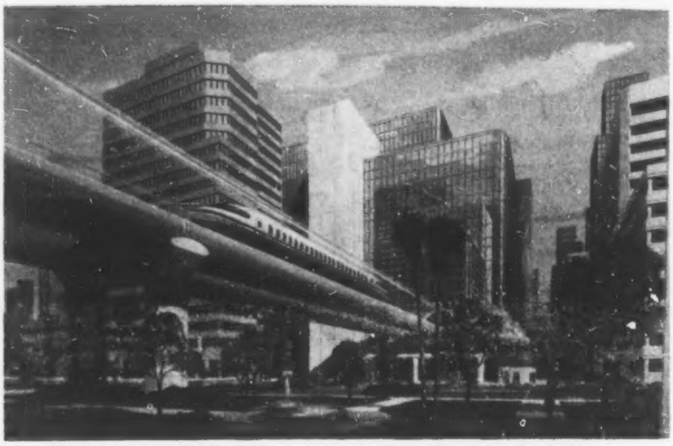
MAGNEPLANE DESIGN:

Cruising Speed	224 mph
Levitation Altitude	10 - 12 inches
Vehicle Capacity	100 passengers
Vehicle Weight	77,000 pounds
Maximum Acceleration	2.2 mph/sec squared
Maximum Headway	3.8 miles
Guideway Capacity	6,000 passengers/hour

POWER REQUIREMENTS:

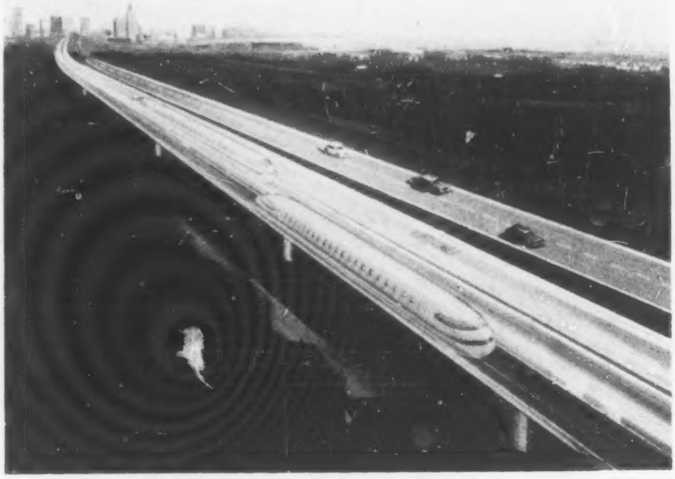
Aerodynamic Drag	3.0 megawatts
Levitation Drag	1.8 megawatts
Propulsion Coil Loss	0.9 megawatts
Other Loss	0.3 megawatts
Total Required	6.0 megawatts

The MAGNEPLANE is the most efficient cost effective system that can be built in Florida. The power consumption is one-tenth of other systems, and the MAGNEPLANE is comparatively noiseless and has almost no effect upon Florida's sensitive ecological balance. The elevated guideway will not require extensive earth work or damage to Florida's wet lands. There is no requirement for grade crossing control. The clear, plastic-type cover over the guideway will prevent high wind velocities' interference with vehicle traffic along transportation corridors and provide the needed security to the transportation and power components.



ARTIST CONCEPT

MAGNEPLANE STATION AREA



ARTIST CONCEPT

MAGNEPLANE GUIDEWAY
along Interstate Highway System

STEEL WHEEL VEHICLE	VS	MAGNEPLANE
Heavy Train		Light Fuselage (737)
1,000 Passengers, once/hour		100 passengers, once/minute
12-stop trips		1-stop or non-stop
on-line loading		off-line loading
100 mph		200 mph
60 megawatts wayside power		6 megawatts wayside power
engineer-controlled		automated
high pressure tracks		low pressure trough
hard rail contact		inertial path
fixed bank		self-banking
limited bank, grade		maneuverable guideway
vibrations, noise		only air noise
active (powered) vehicle		passive (unpowered)
needs a 25 foot square tunnel		fits in a 14 foot pipe

Testimony by
Henry Kolm and David Ramsey,
All American Magneplane, Inc.
5183, Seven Springs Blvd., New Port Richey, FL 33552
813 372 8036

presented to the U. S. House of Representatives
Committee on Science, Space and Technology
Subcommittee on Transportation, Aviation and Materials

at a field hearing on high speed rail technology,
Friday, April 3, 1987, at West Palm Beach, Florida.

SUMMARY

TRAINS ARE 1830 TECHNOLOGY PUSHED TO ITS LIMIT
obsolete, they no longer satisfy our needs, because
people are no longer clustered on an empty planet,
and don't travel city-to-city in straight lines.

MAGNEPLANE IS THE FIRST REALLY NEW CONCEPT, not a train
it is inevitable technology, like the wheel and wing,
perhaps the biggest venture of next century;
if America doesn't lead, we will have to import!

MAGNEPLANE IS GUIDED FLIGHT, not just faster rail
cylindrical vehicle flies inches above aluminum trough
smoothly cushioned, it banks like an airplane,
rides a magnetic wave, which prevents collision
so "cars" can travel non-stop twice a minute
coupled electronically,
using one tenth the wayside power of railroads

MAGNEPLANE HAS A TRACK RECORD AND A FUTURE
invented in 70, prototype developed with NSF funds,
and added support from several industries,
mothballed in 75, ahead of its time;
a new team of companies
backed by private venture capital
is ready to build a magneplane for Florida:
and restore U.S leadership in transportation!

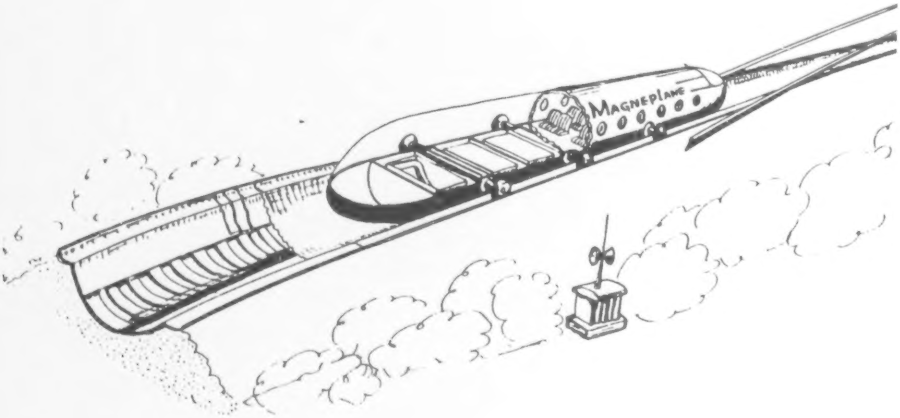
THE MAGNEPLANE TEAM
Henry Kolm, David Ramsey, All American Magneplane,
EML Research and the KAMAN Corporation

MAGNEPLANE ARTICLES FROM THE 70s ARE APPENDED
Scientific American 74, IEEE 72, Cryogenics 75
for those who want to dig deeper.

Magneplanes fly several inches above an aluminum trough,
resiliently supported by their own magnetic image,
free to bank like an airplane
and propelled by a travelling magnetic wave
which is generated by windings in the guideway.

The travelling wave is synchronized with the vehicles
by wayside transformers linked to a central computer
which controls the system and ensures separation.

Vehicles start and stop on retractable wheels,
lift off at about 30 miles per hour, and
carry 100 passengers non-stop to their destination;
all stops are made off the main line.



TRAINS ARE 1830 TECHNOLOGY PUSHED TO ITS LIMIT

Viewed objectively, a train is a very obsolete thing! Consider, next time you climb the stairs into a railway car:

You are climbing onto a huge girder which rides along to concentrate the load on two wheel trucks, just so you can travel on narrow steel rails at an enormous pressure Thousands of pounds per square inch! To be economical, dozens of such cars have to be hitched together, and pulled by a huge locomotive.

Cross-ties and gravel then distribute this concentrated load over the ground, and huge bridges or tunnels are needed when you can't travel at ground level.

In 1830 it was a clever way to move heavy loads over the prairies, even in mud season! But today it is no longer an appropriate means to transport people over a congested planet! Trains are needlessly expensive and cumbersome. Consider:

Trains carry a thousand people once or twice an hour. This means that everybody has to stop everywhere. Electric trains require a large wayside power supply - typically 60 megawatts - which is used only once or twice an hour, mostly to accelerate the people who didn't want to stop. Between trains, the whole system stands idle.

Trains require very heavy bridges and elevation structures, and tunnels which are about 25 feet square for each track, mostly to make room for the huge beam under each coach! Considering that automobiles can drive through a ten foot pipe, a railroad tunnel seems pretty wasteful!

Perhaps a railroad's worst problem is its inability to maneuver! It simply cannot negotiate the grades and curves which are required in the congested countryside of today, particularly at the speeds of tomorrow!

Just to negotiate a 40 foot overpass at 200 mph without passengers being lifted off their seats, a railroad requires over two miles of ramp! There often isn't room for two miles of ramp! Nor for curves of two mile radius!

Railroads were invented just about 200 years ago. In the sixties, new technology was applied to make railroads go as fast as is now possible. The limit isn't much over 100 mph. The time has come for a major re-thinking of the basic problem, not just another round of band-aid modernization!

Remember: we are not building just another generation of airliners, to be obsolete in ten years. We are building the ground transportation system which must take the world through the next century!

MAGNEPLANE IS THE FIRST REALLY NEW CONCEPT

Magneplane addresses the needs of today, and is therefore an inevitable chapter in the evolution of technology, as inevitable as the wheel and the wing were in their day. Its coming cannot be stopped.

If we don't build magneplanes in America, we will be forced to import something very much like it from elsewhere.

Magneplane is a system of individually travelling cars which resemble the fuselage of a small jet (Boeing 737, DC-9).

Magneplanes travel several inches above an aluminum sheet metal trough, free to bank like an airplane. They are supported by a soft cushion of magnetic field, at about one third the pressure of an automobile tire. They resemble a large bobsled more than a train.

By combining a climb with a turn, Magneplanes can negotiate a 40 foot overpass without passengers leaving their seats, using less than a half mile of ramp if need be (a cha~~nd~~elle maneuver).

Magneplanes can travel at a 30 second headway, all vehicles being coupled together electronically. They are loaded and unloaded off-track to make this possible. Thus each magneplane takes its passengers to their destination non-stop or one-stop, like an airliner.

And Magneplane needs only 6 megawatts of wayside power, used twice each minute, instead of 60 megawatts used twice each hour.

Here are the differences between trains and magneplanes:

train	**magneplane**
heavy train	light fuselage (737)
1,000 psysrs, twice/hour	100 psgrs, twice/min
10-stop trips	non-stop or 1-stop trips
cars hard-coupled	electronically coupled
large towns only	can serve many small towns
on-line loading	off-line loading
100 mph	200 mph plus
60 megawatts wayside	6 megawatts wayside power
engineer-controlled	central computer controlled
high pressure tracks	low pressure trough
hard rail contact	soft cushion, inertial path
fixed bank	self-banking
limited bank, grade	maneuverable guideway
vibrations, noise	only air noise
active (powered) vehicle	passive (unpowered)
needs a 25 ft sq tunnel	fits in a 14 ft tube

THESE ARE THE ADVANTAGES WHICH MAKE MAGNEPLANE INEVITABLE

MAGNEPLANE IS GUIDED FLIGHT

Magneplanes resemble small airliners without wings, and are passive: they contain no motor, only several large magnets in the form of superconducting current loops or arrays of permanent magnets under the skin of their underside. They have retractable wheels for landing and take-off.

Lift is produced naturally by the motion of the magnets over the conducting aluminum guideway trough. It results from motion-induced currents in the trough which look like an image of the moving magnets. The moving magnets are repelled by their own induced images! Simple, reliable, and inherently stable!

Induced lift can be felt very simply by holding a permanent magnet near the surface of a spinning aluminum disk. For instance, an aluminum disk on a circular saw arbor (the steel saw blade is not a good enough electrical conductor, and besides, it has dangerous teeth). If the disk is horizontal, the permanent magnet will fly an inch above the surface of the disk.

Induced lift is produced at the expense of drag, just as in the case of aerodynamic lift. The force has several remarkable and useful properties:

lift-off occurs at about 20 to 30 miles per hour

lift force is soft, but stiffens as contact is approached

THE FASTER YOU GO, THE LESS ENERGY IS NEEDED FOR LIFT

at 224 mph, aerodynamic drag is twice the magnetic drag

it therefore doesn't make sense to go much faster

at 224 mph, wayside power required is only 6 megawatts, one tenth the wayside power of a railroad, at six times the passenger handling capacity.

Propulsion is produced by a simple meander winding at the center of the guideway trough. It generates a travelling magnetic wave when energized with three-phase AC current. The magneplane just rides this wave like a surfboard.

The AC current comes from special wayside transformers (cycloconverters) located a mile apart and linked to a central computer. These transformers synchronize the travelling wave with the travelling vehicle on the basis of position information transmitted by the vehicle. They also control the speed of every vehicle, and maintain separation between vehicles.

Wayside transformers also serve as shock absorbers, by damping oscillations of the vehicle. They do this by adjusting the phase and thus the vertical and lateral force of the travelling wave.

More details will be found in the appended articles.

MAGNEPLANE HAS A TRACK RECORD AND A FUTURE

Magneplane was invented in 1970 by Henry Kolm and Richard Thornton of MIT, which owns the three basic patents. It was developed to the point of an operational prototype scale system with support from MIT, the National Science Foundation, and an industrial consortium including Raytheon, Avco, Alcoa, and 3-M. Tests on a 400 foot guideway were highly successful and widely publicised in 1974.

In February 1975 the Office of Management and Budget terminated funding for all high speed ground transportation research in the US. Magneplane was mothballled, with film footage and much technical information unpublished. German, Japanese and Canadian projects adopted some of the basic magneplane concepts (notably the linear synchronous motor approach, but not the self-banking guideway nor the overall system control).

In 1981 Henry Kolm took his applied research group out of the MIT National Magnet Laboratory, and set it up in partnership with Dr. Peter Mongeau, his former graduate student, as Electromagnetic Launch Research Inc. The company is now building the first electromagnetic aircraft catapult, and the first electromagnetic anti-tank gun system under DoD contracts. It is located in one of the first US aircraft plants in Cambridge.

In 1985 EML Research Inc. became part of the Kaman Corporation, a 5,000 employee aerospace team best known for its leading edge technology in general. It is headed by Charlie Kaman, a noted innovator and one of the inventors of the modern helicopter. Kaman makes helicopters for the Navy and advanced components for other major aerospace firms.

In 1982 David Ramsey became involved in the Florida High Speed Rail project, recognized the applicabiity of Magneplane, and eventually founded All American Magneplane, Inc., for the purpose of raising the necessary venture capital to develop a magneplane system for Florida. The financial goal is within reach, and a major development project is scheduled to begin in the summer of 87.

The work will be done by EML/KAMAN under contract from All American Magneplane, Inc., under license from MIT, and under the direct supervision of Henry Kolm and his group.

A fully operational scale system with 2,000 feet of guideway is scheduled for completion in 1989. Design and construction of the full scale system can begin as early as 1990.

Vehicles and prefabricated guideway will be manufactured at a plant to be established in Florida at the time of franchise award.

THE MAGNEPLANE TEAM

Henry Kolm is one of the founders of the MIT Francis Bitter National Magnet Laboratory, an authority on electromagnetic technology with over 25 years of experience, and a recognized inventor, innovator and industrialist. He was named Entrepreneur of the Year 1981 by Money Magazine, and was awarded the Peter Mark Medal by the Department of Defense for outstanding contributions to electromagnetic launch technology.

Kolm is President of Electromagnetic Launch Research Inc., a KAMAN Company, Vice President of Piezo Electric Products Inc., largest US manufacturer of piezoceramics, and a director of All American Magneplane Inc.

After earning his Ph.D. in Physics from MIT in 1955, Kolm developed world record electromagnets, designed the MIT National Magnet Laboratory, and initiated a number of applications including the earliest superconducting magnets, supercritical helium cooling systems, pulsed field metal forming, high gradient magnetic separation and filtration, the magneplane system, and electromagnetic launchers. Kolm has published about 60 professional papers, and holds over 30 US and foreign patents.

David Ramsey is President of All American Magneplane, Inc., President of his own civil engineering firm for fourteen years, and a registered professional engineer in seven states, with twenty-four years of professional experience.

Before engaging in his Florida land development practice, Ramsey earned his BSCE from Marshall University in Huntington, WVA, and served with the Army Corps of Engineers.

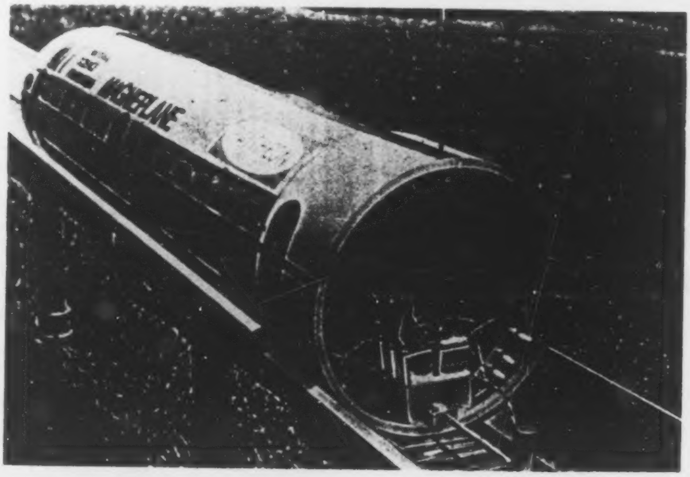
All American Magneplane Inc. is a Florida Corporation founded in 1984 for the purpose of financing the development of a practical magneplane system for Florida, and the World.

Electromagnetic Launch Research Inc., a member of the Kaman Diversified Technologies group, is a world class research team involved in leading edge power technology. It is backed by one of the most advanced manufacturing organizations in the World today.

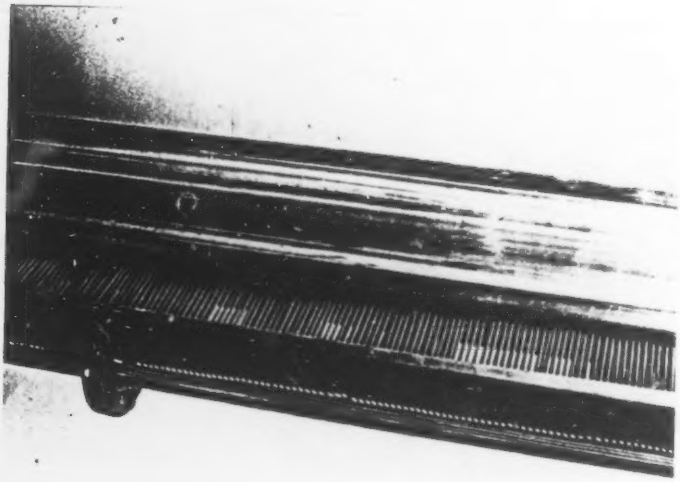
MAGNEPLANE ARTICLES FROM THE SEVENTIES ARE APPENDED:

Electromagnetic Flight
    Scientific American, October 1973
The Magneplane: Guided Electromagnetic Flight
    Proceedings of the 1972 Applied Superconductivity Conference
        (the first magneplane publication)
The Magneplane System
    Cryogenics, July 1975
        (the last magneplane publication)

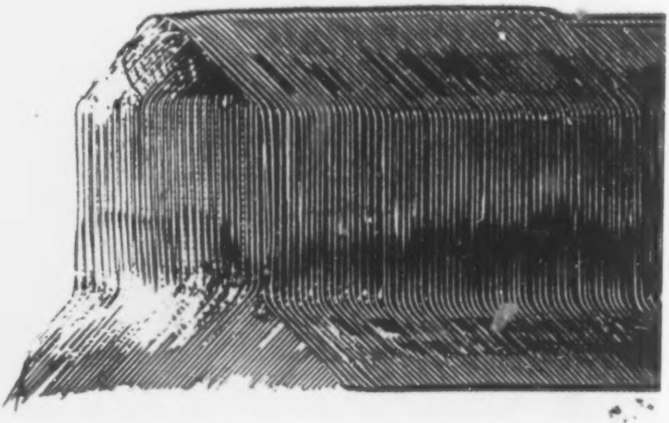
1/25 scale magneplane, travelling at 56 mph on 400 ft guideway; built and tested in 1974 by the MIT-Raytheon-Avco team, with support from the National Science Foundation.



Close-up of magneplane vehicle, showing position sensor probe and telemetering equipment which maintains synchronism.



Magneplane guideway trough, with lift surfaces on both sides and propulsion windings in center slot. Slot also provides "magnetic keel" to stabilize roll motion



Propulsion winding which generates travelling magnetic wave. A 36-wire meander, it can be fed with 3-phase AC at synchronous frequency.

THE MAGNEPLANE: GUIDED ELECTROMAGNETIC FLIGHT

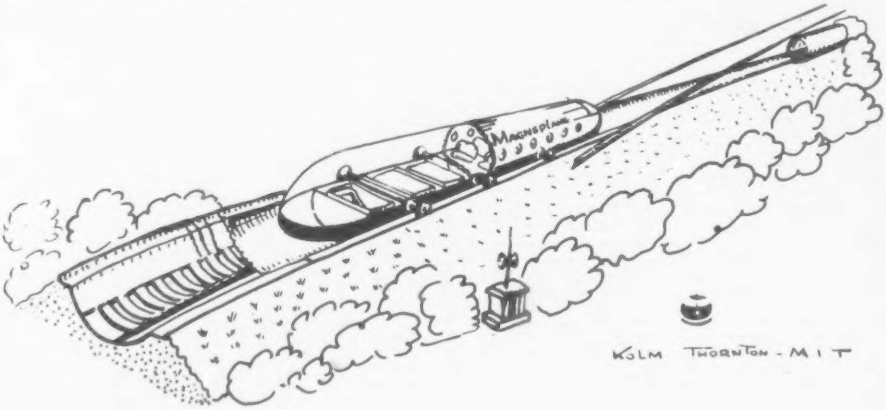
Henry H. Kolm and Richard D. Thornton

Massachusetts Institute of Technology

Cambridge, Massachusetts

Summary

A cylindrical vehicle equipped with superconducting coils is suspended resiliently by eddy current repulsion one foot above a cylindrical, trough-shaped aluminum guideway surrounding the lower third of the vehicle's circumference. The vehicle is free to roll so as to assume the correct bank angle in curves. It is propelled by a travelling magnetic field generated by current loops which form an integral part of the guideway. This field is synchronized by wayside control units on the basis of information transmitted from the vehicle; it reacts against the superconducting vehicle coils to provide synchronous acceleration, deceleration or cruise, and also generates vertical and lateral forces to apply active damping to oscillations in the heave, sway, pitch, yaw and roll modes. Lift-to-drag ratio is about 20 at 250 mph, propulsion efficiency is about 80%, and guideway loading is about 2 psi. Due to the uniform distribution of vehicle weight and the large suspension clearance, guideway alignment and rigidity are not very critical. This makes possible a reasonably priced active guideway. It weighs about as much as conventional rails (100 pounds per foot), requires no additional support structure, and can be laminated continuously from rolls of aluminum and fiberglass, suitably folded and interleaved. The vehicle is carried on retractable wheels until it reaches a velocity of about 40 mph; it can be operated in the open up to 300 mph, and in a partially evacuated tunnel up to and beyond jet aircraft speeds. On the basis of detailed study, we believe that the magneplane represents an economically viable transportation system realizable with existing technology and superior to any of the alternatives presently under consideration or development.



Defining the Problem

The magneplane system is intended to provide the best overall solution to meeting the basic requirements of high speed ground transportation. It is important to define these requirements and their implications.

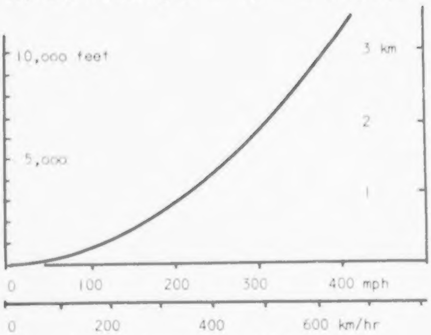
Long Range Alignment

Upward forces on passengers represent the least stringent constraint imposed by ride quality requirements. For aircraft, sustained 30° banked turns are standard instrument approach procedure in holding patterns, and even 45° turns are barely detectable to the senses. It is therefore reasonable to permit guideway curves resulting in a maximum centrifugal acceleration of 1g, corresponding to a 45° bank and a 0.41g up force on passengers, *providing accurately coordinated banking can be maintained throughout the curve, and at any instantaneous vehicle speed.* This condition permits a minimum turn radius of 4,000 ft at

---

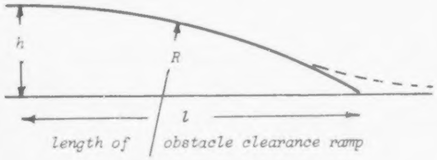
Work supported by the Massachusetts Institute of Technology, the AVCO Systems Division, and the RAYTHEON Equipment Division, with assistance from the Minnesota Mining and Manufacturing Company, and the Aluminum Company of America.

250 mph, increasing as the square of velocity:



Radius of one gee or 45° banked turn

Downward and sideward passenger forces are considerably more critical. A limit of 0.01g has been suggested for sustained downward and sideward forces. To understand the implications of this limit, consider the ramp length l required to clear an obstacle of height h at a permissible guideway curvature of radius R. These quantities are related to a good approximation by the expression $l \approx \sqrt{2Rh}$



For a typical highway overpass, h might be 20 ft and l about 400 ft. R would then correspond to the 1g turn radius at 250 mph, meaning that the vehicle would just begin to leave the guideway and the passengers would experience weightlessness. To maintain the down force below .01g, a 20 ft overpass requires an approach ramp length of *one mile* at 250 mph. It is obvious that it will sometimes be necessary to artificially add upward force by a simultaneous banked curve in order to clear a terrain obstacle in the available space, a maneuver known in aviation as a chandelle. Conversely, it may sometimes prove expedient to use an artificial rise in order to negotiate a curve which would otherwise require excessive banking.

The conclusions regarding long range alignment are obvious: any high speed guideway will require more extensive terrain adaptation than can reasonably be accomplished by cutting and filling. There will have to be extended sections of elevated construction, and their cost will be a critical consideration. This implies that deflection tolerances must be kept lenient and maintained by significant reliance on inertia to supplement static strength; it requires a dynamic space-age approach to civil engineering. It also implies the importance of a vehicle resiliently suspended at a large clearance gap, with freedom to roll into a continuously coordinated bank, regardless of its instantaneous speed.

Short Range Alignment

Short range alignment imposes the most severe speed limit on ground travel because no previously proposed suspension system will permit very high speeds on a guideway of realistically maintainable perfection. Wheel vehicles with elastic articulated suspensions are limited in frequency response by the finite ratio of sprung to unsprung weight. Wheel-less vehicles operating at a clearance gap of about one inch require a secondary articulation subject to the same limitation, regardless of whether they are supported by an air cushion derived from fans or ram wings, or magnetic forces derived from eddy current repulsion or ferromagnetic attraction. Traction magnet suspensions developed by Messerschmitt-Bölkow-Blohm and Krauss-Maffei in Germany overcome the inherent instability of magnetic attraction by using active feed-back control of the electromagnet current to maintain a desired clearance gap. There is a widespread but erroneous belief that this eliminates the short range alignment limitation because the active suspension can compensate for guideway undulations and maintain the vehicle in smooth motion. Ferromagnetic attraction suspensions must operate at a clearance gap no larger than one centimeter, which is no larger than realistic guideway undulations. Moreover, electrical inductance of the suspension magnets plays the same role as the unsprung inertia of mechanical suspensions by imposing a limit on frequency response: the on-board reactive power required to maintain a constant clearance gap increases as v^3 and can reach several megawatts at 300 mph; moreover, no amount of feed-back will prevent contact if the guideway should drop faster than the vehicle can drop long enough to close the 1 cm gap.

Stringent short-range alignment tolerances will obviously dominate both the construction and maintenance cost of any small gap guideway. This cost represents the price of ride quality for any suspension system proposed thus far. Unfortunately there is no reliable quantitative information regarding the cost of a given tolerance under given terrain conditions, or the criteria which define the limits of acceptable ride quality. Certain assumptions appear justified.

Ride quality which is noticeably inferior to that offered by a jet airliner at cruising altitude is not likely to be acceptable to the public. We are competing with airliners, not with trains or automobiles or buses.

Alignment tolerances more stringent than about a one inch excursion (two inch undulation amplitude) are likely to prove prohibitive because they will require massive structural support to limit elastic span deflections and plastic settlement deformations, and because they will require continuous adjustment provisions to compensate for earth motion. Significantly better alignment tolerances are required only in the construction of elementary particle accelerators where guideway cost is not a consideration. The Stanford Linear Accelerator operates in a two mile tunnel of monolithic reenforced concrete 12 ft thick on the bottom and 6 ft thick along walls and roof. To be sure, the tolerances are even more stringent than those required for attraction magnet suspensions, but it is significant that even this massive tunnel failed to maintain alignment between periodic adjustments of the beam tube; an active magnetic beam bending system had to be developed to compensate for continuous earth motion. The Japanese have the most relevant experience in maintaining guideway alignment; they place the upper limit of conventional suspensions at about 200 mph, but have found it impractical to operate the New Tokaido Line above 130 to 150 mph. There is no reason to expect any of the small gap wheelless suspensions to do any better under acceptable ride quality conditions, even with secondary articulation.

It is clear that short range alignment considerations strongly favor a vehicle suspended at a clearance gap significantly larger than the amplitude of realistic guideway undulations.

Propulsion

Propulsion must be silent, pollution-free, reasonably efficient, and compatible with the suspension system. The only serious candidate for propulsion of any wheel-less vehicles is the *linear motor*.

It can be of the *active guideway* variety in which power is supplied to windings in the guideway, or the *active vehicle* variety in which power is supplied to windings in the vehicle. The active vehicle approach requires transmission of power to the vehicle since on-board generation is not practical. Numerous studies have examined ways to transmit power, but to date only sliding contacts have been found to be feasible.

In addition to the choice between active guideway and active vehicle, there is a choice between *linear induction* and *linear synchronous motors*. In the induction motor, the active windings induce eddy currents in an aluminum reaction rail, and then produce propulsive force by interaction of the excitation field with the induced field. The induction motor has the advantage of a potentially simple aluminum reaction rail and the ability to provide a force even when the electrical frequency is not perfectly synchronized with the vehicle speed. It has the disadvantage of requiring a relatively large field by the excitation winding, with a very low power factor when the air gap is large. The linear synchronous motor has the advantage of requiring less field from the active winding and generally has a higher electrical efficiency, however it requires a static field on the inactive member (we are not considering reluctance type motors), and there must be perfect synchronism between the excitation frequency and the vehicle speed. The conventional dc machine is really just a synchronous machine in which synchronization is assured by a mechanical commutator rotating at the same speed as the magnetic field.

All linear motors also require substantial *power conditioning equipment* to convert the available constant voltage 60 Hz power to variable voltage, variable frequency power as required for acceleration, cruise or deceleration. This equipment tends to be heavy and bulky, with substantial cost penalties for any attempts to reduce weight. Generally speaking, it appears that systems with an active guideway would have wayside power conditioning, while systems with an active vehicle would have on-board power conditioning.

It appears that the only viable choices reduce to a linear induction motor with an active vehicle and an aluminum reaction rail on the guideway, or a linear synchronous motor with an active guideway and a static magnetic field on the vehicle. The active guideway linear induction motor requires too strong a field on the guideway to be practical, and the linear synchronous motor with an active vehicle would require a prohibitively expensive structure for providing a static field on the guideway.

In *comparing* the *active vehicle induction motor* system with the *passive vehicle synchronous motor* system, there is a very strong indication that the latter is the most appropriate for the magneplane, while the former is more appropriate for an air cushion vehicle. The difference is that the magneplane already has a strong on-board field and operates at a large clearance, while the air cushion vehicle does not have an on-board field and operates at a small clearance. It might appear to be excessively expensive to provide a propulsion winding along the entire guideway, but in fact detailed cost studies show that this winding does not in any way dominate the cost of guideway construction. Moreover, the number of power conditioning stations is about the same whether they are located every 5 miles along the guideway, or on every vehicle which passes over it. However, there is a substantial cost advantage in using wayside conditioning, where it is possible to use heavy power trransformers and bulky capacitors and circuit breakers.The economy is further enhanced by an important bootstrap effect in that the active guideway leads to a lighter vehicle and therefore lower total power requirements. As a point of comparison, the experimental air cushion vehicle being tested at Pueblo, Colorado has some 25,000 pounds of (non-paying) weight in the form of its linear motor apparatus.

The synchronous motor approach has an added advantage in that it lends itself naturally to an *active ride control system*. The guideway coils can be excited in such a way as to provide controlled vertical and lateral forces in addition to the propulsion force. Since it has not been possible so far to conceive a satisfactory passive ride control system, this feature has assumed considerable importance.

The magneplane concept is the logical solution to the high speed ground transportation problem if all of the boundary conditions defined above are taken into consideration. What makes it possible, in essence, is *the application of aero-space techniques not familiar within the context of ground transportation engineering: the active control of vehicle dynamics on the basis of telemetered information.* The transmission of information *from* a high-speed vehicle is a trivial problem compared to the transmission of power *to* the vehicle, regardless of whether the vehicle is in lunar orbit, or travelling at an altitude of twelve inches above the earth.

The Magneplane System

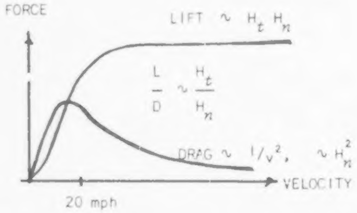
Principles of Electromagnetic Flight

A magnet moving above a conductive plate is repelled by the eddy currents its motion induces in the plate. This effect represents the electromagnetic analog of aerodynamic flight in that motion produces lift at the expense of drag.

Electromagnetic flight differs from aerodynamic flight in one essential respect: *the lift force increases very steeply as the magnet approaches the conductive plate.* The magneplane utilizes this characteristic to achieve *guided flight*: it is supported resiliently at an altitude of one foot instead of a clearance gap of one inch. Like an airplane, it is therefore free to follow a smooth trajectory governed by its inertia and relatively unaffected by the high-frequency undulations of its guideway, since these undulations can realistically be kept much smaller than the altitude.

The adoption of a *cylindrical rather than a planar geometry* also provides freedom about the vehicle's roll axis, which permits it to assume an accurately coordinated bank angle. The resiliency and roll-freedom together eliminate the need for an articulated suspension or an unrealistically smooth guideway which is accurately banked for a pre-determined instantaneous speed, unrealizable in practice. The magneplane guideway may undulate with an amplitude of about one inch, and it needs to be banked at only approximately the correct angle.

Lift and Drag Forces characteristic of electromagnetic flight exhibit the following velocity dependence:



Lift increases to a constant high-speed limit, the shape of its "saturation curve" depending critically on magnetic field configuration and guideway shape and thickness. The high speed limit is typically reached at about 40 mph and is proportional to the product of the normal and tangential magnetic field components at the guideway surface when the vehicle is stationary, before they are perturbed by induced eddy currents. If each field component is 10 kgauss (1 tesla), the lift force is 60 psi, which is equivalent to the pressure in a bus tire. This means that at the small clearance gaps envisaged previously, a wheel-less vehicle could be supported by magnets having a footprint area no larger than that of a bus. In contrast, the magneplane vehicle is supported by field components of only 2 kgauss (.2 tesla) at the guideway surface, resulting in a lift force of only 2.4 psi. This uniform distribution of vehicle weight greatly reduces structural demands imposed on the guideway, and represents another essential advantage of the magneplane concept.

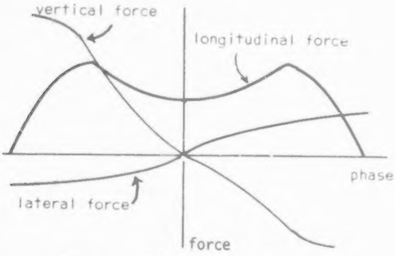
Drag reaches a prohibitive peak at a critical velocity of about 15 to 20 mph, and then decreases with increasing velocity. Contrary to aerodynamic drag, electromagnetic drag favors high speed travel: *less total energy is dissipated when travelling a given distance at higher speed.* Drag is also proportional to the normal field component squared. The ratio of lift to drag is thus proportional to the ratio of tangential to normal field components; it is about 20 for a magneplane travelling at 250 mph.

Damping of oscillations is very low in electromagnetic flight, and provisions must be made to increase it artificially. Various passive methods based on viscous and eddy-current elements have been considered, but none are effective at the low frequencies which appear to predominate, with the possible exception of the roll mode. Fortunately active damping can be applied readily by means of the propulsion system. It should be noted in this connection that the *active damping* used in the magneplane system differs in a very fundamental way from the *active suspensions* discussed earlier in connection with the ferromagnetic attraction suspensions. The latter are inherently unstable, and the active control must compensate all guideway undulations at any frequency; if control is lost, there is only 1 cm to violent impact. In contrast, magneplanes are inherently stable and the active ride control serves only to prevent the build-up of resonant oscillations of low frequency; its control forces are properly timed but relatively small, and they are not required to respond to high frequency undulations of the guideway; vehicle inertia serves to attenuate high frequency undulations.

Principles of Synchronous Propulsion

The strong and physically large magnetic dipoles required to achieve levitation at an altitude of one foot are also used to achieve efficient propulsion. For this purpose, conductors imbedded in the guideway generate a magnetic field having the same periodicity in space as the levitation magnets. This magnetic field is made to travel in synchronism with the vehicle by adjusting its frequency; its phase position with respect to the vehicle and its amplitude are adjusted to provide acceleration or deceleration as required by information transmitted from sensors and a command unit aboard the vehicle to wayside power control units.

The propulsion system also applies controlled vertical and lateral forces which serve to apply active damping to oscillations in the sway, heave, pitch, yaw and roll modes. For this purpose an adjustable quadrature component of the propulsion field is added. The forces applied by the propulsion system depend on the position of the vehicle with respect to the phase of the travelling synchronous field in the manner indicated in the following composite diagram:



Forces applied by propulsion system

Methods of Magneplane Research

Analytical and digital computation provides a basic understanding of the very complicated dynamic interactions involved in electromagnetic flight. As in the case of aerodynamic flight, experimental techniques must be used to reconcile the necessarily approximate nature of theoretical results with detailed reality, including edge effects, end effects, higher order transient effects, mode coupling effects, etc. Unfortunately modeling experiments are not as simple as those conducted in a wind tunnel: the skin depth of a magnetic field penetrating into a metal does not scale; it depends only on absolute frequency, or absolute velocity of the travelling magnet. Several methods of experimental measurement have been devised.

Static simulation makes use of a vehicle containing levitation coils energized with a variable high frequency current. This model is floated in an aluminum guideway trough by the induced repulsion, making it possible to study the effect of different guideway configurations on heave, pitch, sway, yaw and roll stability. To obtain quantitative measurements of the restoring force profiles and drag forces, the loaded impedance of the vehicle coils is measured as a function of vehicle position.

Rotating disk simulation is a useful means for determining the dependence of lift and drag on skin depth and edge effects. A samarium cobalt vehicle magnet was suspended on a force balance above the contoured edge of a 6 ft diameter aluminum disk 1 inch thick, rotating at speeds up to 650 rpm, equivalent to 138 mph.

Towing tests with a 1/25 scale magneplane model were performed at speeds up to 32 mph in a straight guideway 9 inches in diameter, 130 ft long. Two vehicles were used: the first is one half of scaled length and contains ten alnico 8 magnets to simulate the superconducting coils; these produce a field of only 400 gauss at the levitation altitude of .5 inch. The second vehicle is only one quarter scaled length and contains four samarium cobalt magnets producing 2 kgauss at the guideway. The dynamics of electromagnetic flight are clearly discernible, and the effect of different guideway configurations was analyzed by slow motion film records made as the vehicle passed over different test sections inserted in the guideway. It is not practical to reach speeds significantly above the critical velocity by towing methods, nor would the effort lead to meaningful results. Electromagnetic flight cannot be studied without an actively controlled propulsion system.

A fully operational magneplane system of 1/25 scale is therefore being constructed. It was originally intended to exhibit this system at TRANSPO 72, but time and financial limitations made it impossible to guarantee meeting the deadline. It will therefore be exhibited independently at a later date, and will also be used as the basis for a documentary film on electromagnetic flight.

The vehicle contains 20 pounds of samarium-cobalt magnets, the largest concentration of rare earth magnets in the world (not including the wheel-motor magnets of the lunar rover vehicles, both of which are no longer on earth). It will also contain all the sensing, signal processing and telemetering equipment needed to provide feedback stabilization. It will be about one half scale length (45 in) and weigh 50 pounds.

The guideway is an exact scale prototype of the full size version described later. It is being laminated in ten foot sections from punched meander strips of .020 in thick aluminum, using a newly developed stage B epoxy bonding film kindly supplied by the 3M Company. The first system will consist of 360 ft of straight guideway, terminated at each end by a launching section containing only propulsion conductors, and an emergency overrun section to apply passive braking in the event the propulsion system should fail to stop the vehicle. This guideway is adequate to permit 100 ft of constant cruise at 45 mph. It will later be extended into an oval racetrack to study banking stability in curve entry and roll-out, and the effects of switching propulsion power from block to block.

The power conditioning equipment has been completed and control systems are under construction. The basic cycloconverter supplies 3-phase power at 100 amp and 100 volts peak per phase, the frequency being continuously variable to 150 Hz. This will achieve 45 mph in 100 ft, on a 200 ft energized length of guideway.

Design of a Full Scale Magneplane

Evaluation of the magneplane concept requires the design of a first-generation optimized system. It has been assumed that a speed in the 250 mph range is reasonable: it will be adequate for high-density corridors where trips are relatively short and terrain congestion requires reasonably compact curves and ramps. Higher speeds will become practical in long-haul systems over open terrain, but air drag becomes prohibitive above 300 mph and requires operation in a partially evacuated tunnel. The following design parameters appear logical:

CRUISING SPEED	100 m/s = 224 mph
LEVITATION ALTITUDE	25 cm = 10 inches
VEHICLE CAPACITY	100 passengers
VEHICLE WEIGHT, LOADED	35 Mg = 77,000 pounds
MAXIMUM ACCELERATION	1 m/s^2 = 2.2 mph/sec^2
MINIMUM HEADWAY	6 km = 3.8 miles (stat)
GUIDEWAY CAPACITY	6,000 passengers/hour

they result in the following power requirements:

AERODYNAMIC DRAG	3	Megawatts
LEVITATION DRAG	1.8	
PROPULSION COIL LOSS	.9	
OTHER LOSSES	.3	
TOTAL REQUIRED	6	Megawatts

suggesting a linear synchronous motor characterized by the following parameters:

MAXIMUM PROPULSIVE FORCE	.2g = 70 knewtons
PEAK POWER OUTPUT	7 Mwatts/vehicle
AVERAGE EFFICIENCY	80%
GUIDEWAY BLOCK LENGTH	1 km
MAXIMUM FREQUENCY	20 Hz
POLE PITCH	2.5 meter

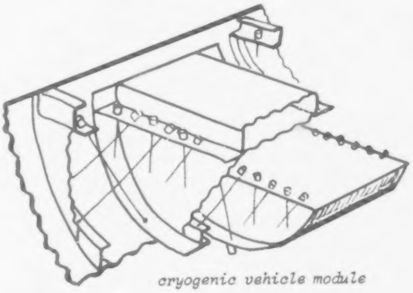
Small vehicles operating at tight headway separations are an absolute necessity to permit the flexible scheduling of airlines instead of requiring the multi-stop, infrequent service of railways. It requires in turn positive control of all vehicles in the system, and off-line loading and unloading, with provisions for switching vehicles off and onto the main guideway non-stop.

The Vehicle

A magneplane resembles the fuselage of a medium airliner, 4m in diameter and 40m in length. As shown on the title page, it consists of a passenger cabin (easily replaced by a cargo container) and a structural chassis divided into eleven compartments by structural bulkheads. Five alternate compartments contain cryogenic modules, each housing a square superconducting pancake coil, bent so as to conform to the lower third of the vehicle's circumference. Each pancake coil is 4m in developed width and 2.5m long in the direction of motion, neighboring coils having a center-to-center spacing of 5m. Each coil is made of NbTi filaments imbedded in a flat aluminum ribbon and carries 600,000 amp-turns of persistent current in the same direction. The chassis is therefore surrounded by a magnetic field pointing alternately outward and inward, with ten alternately directed poles of 2.5m pole pitch generated by the five cryogenic modules.

Each coil carries supplementary windings in its central region so as to generate a higher field intensity along the centerline of the magneplane. This *magnetic keel* was found to be necessary to provide increased righting moment, increased centering force, increased propulsion coupling, and a means to apply active roll damping. The magnetic keel compensates for the destabilizing forces applied by the outermost edges of the guideway levitation strips. Near the center, in the upper portion of the helium container in each cryogenic module there is a field cancelling coil which carries several percent of the current of the main superconducting coil in order to reduce the magnetic field in the passenger cabin to a maximum of 200 gauss near the floor.

The cryogenic modules which provide thermal and structural containment for the superconducting coils are designed on the basis of techniques and concepts developed and tested in conjunction with a large *hybrid magnet* constructed at the MIT Francis Bitter National Magnet Laboratory. The forces exerted between the inner 200 kgauss water-cooled Bitter solenoid magnets and the 60 kgauss superconducting pancakes which surround them present force containment problems considerably more severe than those of the magneplane modules, and they were solved at a total helium boil-off rate of 1.5 liters/hr. Helium boil-off for all five modules of the magneplane is estimated conservatively at 10 liters/hr, which permits re-filling the helium and nitrogen reservoirs at 12 hour intervals along with other routine servicing and cleaning. Evaporated helium will be re-compressed by small on-board compressors and stored for re-liquefaction. Closed-cycle refrigerators may ultimately prove expedient when the art has achieved adequate reliability. The design of the cryogenic modules is illustrated below; they comprise three nesting containers, the outermost being an evacuated compartment of the chassis; the innermost contains the superconducting coils and the helium supply, while the intermediate one contains a liquid nitrogen reservoir and serves as heat shield. Tension spokes interconnect the three containers to minimize heat loss. To further reduce the average heat loss, each spoke is anchored by means of an elastic element which



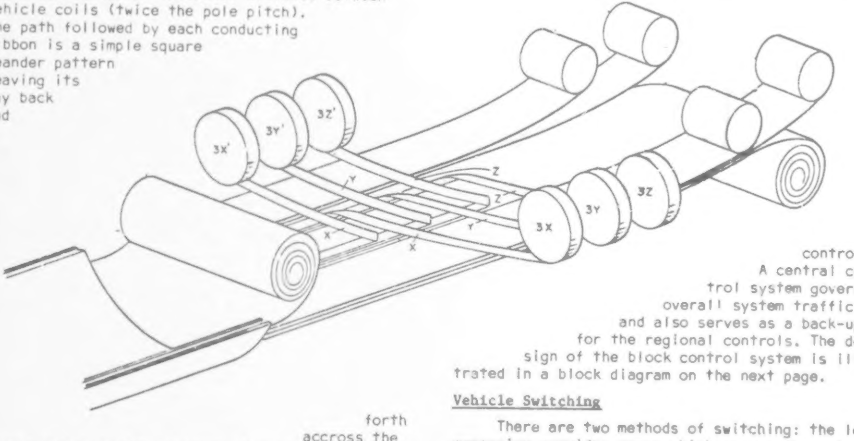
cryogenic vehicle module

introduces thermal resistance under normal conditions but permits solid contact when a shock force requires the full tensile strength of a particular spoke.

The empty bulkhead compartments between coils contain hydraulic cylinders which serve to extend the landing gear outward and downward so as to carry the vehicle on the guideway rim while it is being accelerated or decelerated below levitation velocity on special non-levitating, low-drag guideway sections near stations and switching ramps. Emergency stops between stations are made on skids. Magnetic phase sensors, accelerometers, gyro-sensors, signal processing and telemetering equipment is housed in the nose and tail sections. These are shaped so as to minimize aerodynamic effects on angle of attack and provide added lift at high speed by ram-wing effect.

The Guideway

The guideway is a laminated trough of aluminum and fiberglass surrounding about one third of the vehicle's circumference. It weighs about as much as medium duty rails (100 lbs/ft), all of the structure serving both mechanical and electrical functions. It has a developed width of about 6m, and its thickness tapers from 1.5cm at the outside to 1cm near the center. It is divided longitudinally into three strips of about equal width. The outer strips are essentially solid aluminum and serve to provide levitation. The center strip is crossed by transverse conducting ribbons supplied with a multi-phase current to generate a travelling magnetic field with a spatial wavelength equal to the center-to-center distance between vehicle coils (twice the pole pitch). The path followed by each conducting ribbon is a simple square meander pattern weaving its way back and forth accross the center strip of the guideway. The entire structure is permanently sealed without any exposed voltages. It is an essential feature of this guideway that it can be fabricated continuously by an automated fixture performing the operations indicated in the above drawing. The 1/25 scale guideway is being laminated in this manner, except that pre-punched meanders are used instead of meanders folded from ribbon. This technique is successful and has a number of advantages, but it is possible that a different method will prove more expedient under full-scale conditions. One could envisage, for example, insulated cables laid in an extruded channel which is subsequently filled with concrete.



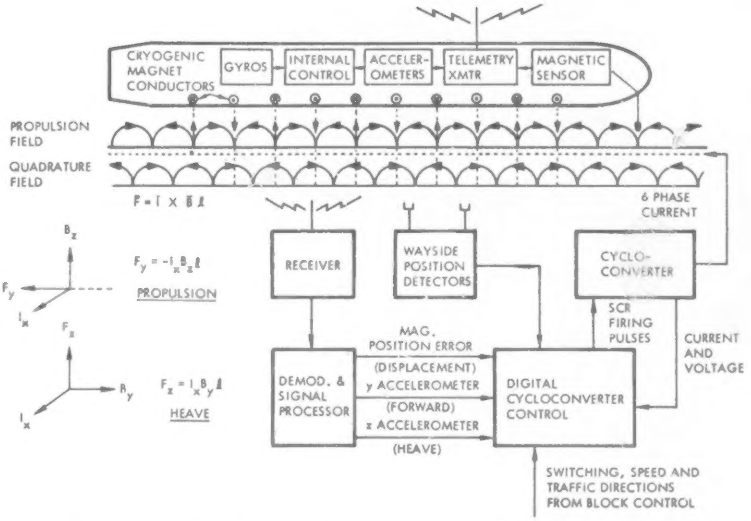
The Control System

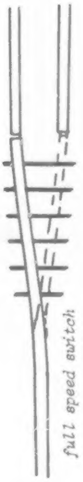
The guideway is divided into electrically independent blocks. Optimum block length is a tradeoff: reactive and resistive losses impose an upper limit, while power unit cost imposes a lower limit. The optimum lies between 2 and 5 miles. The power unit for each block contains two or more cycloconverters which are capable of supplying the east-bound and west-bound sections of the block with current of continuously variable frequency, amplitude and phase. This current is controlled by signals transmitted from the vehicle to provide synchronous acceleration, deceleration or cruise. As described earlier, the cycloconverter also applies vertical and lateral forces for active damping of oscillations by adding a controlled quadrature field component.

The block control also performs certain system functions. It turns power on as a vehicle is "handed off" by a neighboring block without discontinuity in phase, frequency or amplitude. It over-rules the vehicle commands if necessary to maintain a minimum positive vehicle separation on the basis of inputs from a regional control system which interconnects neighboring block controls. A central control system governs overall system traffic, and also serves as a back-up for the regional controls. The design of the block control system is illustrated in a block diagram on the next page.

Vehicle Switching

There are two methods of switching: the least expensive provides ramps which engage the extended landing gear and carry the vehicle to an overhead station, as indicated on the title page drawing. This method requires that the vehicle decelerate to a landing speed of about 100 mph. The second method permits switching at full cruising speed: it requires about one mile of guideway mounted on


CRYOGENIC MAGNET CONDUCTORS
GYROS
INTERNAL CONTROL
ACCELER-OMETERS
TELEMETRY XMTR
MAGNETIC SENSOR
PROPULSION FIELD
QUADRATURE FIELD
$F = I \times B \ell$
6 PHASE CURRENT
B_z
F_y
I_x
$F_y = -I_x B_z \ell$
PROPULSION
F_z
B_y
I_x
$F_z = I_x B_y \ell$
HEAVE
RECEIVER
WAYSIDE POSITION DETECTORS
CYCLO-CONVERTER
SCR FIRING PULSES
CURRENT AND VOLTAGE
MAG. POSITION ERROR
(DISPLACEMENT)
y ACCELEROMETER
(FORWARD)
z ACCELEROMETER
(HEAVE)
DEMOD. & SIGNAL PROCESSOR
DIGITAL CYCLOCONVERTER CONTROL
SWITCHING, SPEED AND TRAFFIC DIRECTIONS FROM BLOCK CONTROL


full speed switch

sliding cradles which bend it elastically into a gentle banked curve feeding into one of two or three neighboring guideways, as illustrated above at right.

System Economics

All high speed ground transportation systems seem to have the attribute that the amortized fixed cost of the guideway dominates the operating cost of the system. Moreover, most of the cost of the guideway pays for moving earth, pouring concrete and building bridges. This is a reflection of the fact that high speeds require meticulous track or guideway alignment in both horizontal and vertical dimensions. Improved rail systems offer no advantage; at speeds of 150 mph the expense of maintaining conventional rail service becomes prohibitive, and the expense as well as the difficulties tend to increase as the square of speed. At speeds of 225 mph and beyond, no existing system is adequate and entirely new track or guideway structures must be built. It appears that rail, air cushion, and magnetic levitation will all lead to comparable guideway cost, with each system having its own particular merits, but no overriding cost advantage or disadvantage. It is clear that *the only* way to reduce per-passenger cost is to ensure a very large number of passengers. *The overriding economic consideration therefore is the degree of public acceptance of a particular transportation system*, and public acceptance hinges upon attributes such as speed, comfort, ride quality, dependability, scheduling, etc. It is instructive to note that the success of the Xerox process stands as a monument to the above proposition. *It is based on faith in the fact that a 35,000 dollar copy machine can successfully compete with existing 200 dollar machines by public acceptance based entirely on attributes of convenience.* The Xerox process demonstrates the power of a winning concept implemented by a winning philosophy.

To illustrate the economics quantitatively, let us assume that a two-way system costs between 4 and 10 million dollars per mile, depending on terrain, land cost, number of bridges, etc.; this range is a typical conclusion of various studies. Assuming a yearly expense at 10% of capital cost, the annual expense is 200 k$ to 500 k$ per mile of one-way guideway. Neglecting any possible freight or real estate revenue, we see that for 10 million passengers per year the guideway cost is 2¢ to 5¢ per passenger mile, while for 50 million passengers the cost is only 0.4¢ to 1¢ per passenger mile. Costs other than guideway will add only 1¢ to 2¢ to these figures, representing energy consumption, vehicle and station costs. *Unless the number of passengers is nearer 50 million than 10 million, the fixed cost will dominate.* Unfortunately it appears that in the US, initial designs must be based on figures closer to 10 million passengers per year.

Capacity for future evolution must be a prime consideration in the design of the first magneplane. It must be built initially at minimum cost and capacity, but in such a way as to permit adaptive growth. The evolution envisaged would start at 100-passenger vehicles and 60 second headway in order to minimize power system cost and station cost. This leads to a theoretical capacity of 60 million seats per year, or a practical capacity of 15 to 20 million passengers. As the technology improves, vehicle size can be increased to 150 passengers and headway reduced to 30 seconds. These changes require higher speed switching, longer off-line acceleration and deceleration lanes, and more frequent wayside power converters. These changes would be made selectively where demand requires; the basic guideway would not have to be re-built.

We thus reach the interesting conclusion that a magneplane system can operate initially at costs comparable to jet aircraft on short runs in congested areas, but that as passengers increase, the system can be expanded to meet the potential demand for a long time into the future, and at a decreasing cost per passenger mile. This is in contrast to existing short-haul, high density jet aircraft travel where there is little room for future expansion, and where costs are rising sharply rather than dropping.

The Magneplane Project

The initial concept of magneplane evolved between June 1970 and July 1971 as the result of a particularly broad look at the overall problem, from the vantage point of a fortuitous combination of background experience. *Thornton* was a member of Project Transport, a broad study of HSGT conducted at MIT for the DOT in the mid-sixties; he concentrated specifically on linear induction motor development. Later he became involved in the development of electric cars, and in this context he invented a sophisticated method for the synthetic synchronization of rotary synchronous motors. This work lead to practical expertise in the area which combines electromagnetic theory, high power electronics, control theory, dynamic analysis, power conditioning, and related manufacturing technology. *Kolm* has a background in low temperature and solid state physics and cryogenic engineering, the generation of very intense magnetic fields both pulsed and continuous, and their application to research and industry, the development of superconducting magnet systems, and familiarity with the associated mechanical, thermodynamic and electromagnetic problems. He also has some experience in structures and soil mechanics, acquired while working for a structural testing firm and during field service with the Corps of Engineers, involving the construction of bridges and roads. Both authors have a well-developed feeling for vehicle dynamics, acquired in Thornton's case by years of serious sailing, and in Kolm's case by years of motorcycling and some thousand hours of serious flying (he holds a current commercial pilot license). We feel it necessary to cite these qualifications in justification of the rather broad assertions we make.

The Magneplane Team was formed in November 1971 and includes some thirty senior scientists and engineers identified below. The work was supported entirely by MIT, the AVCO Systems Division, and the RAYTHEON Equipment Division, at a total commitment of about 300 k$. There has also been generous contribution of evening and weekend time by all the team members. In addition to staff time, the organizations have made available many unique resources. These include priceless computer software, support personnel, and facilities. Avco for example constructed the 6 ft diameter rotating disk facility in record time by adapting an existing dynamic balancing jig, while Raytheon made available within two weeks the world's largest supply of rare earth magnets.

Motivation for the effort is the belief that the magneplane concept represents the winning approach to the problem of high speed ground transportation, and therefore holds the key to world leadership in one of the prime technological markets of the next several decades. Leadership in this market is vital not only to the organizations involved, but to the economic health of the entire aerospace and electronics industry. Beyond such competitive considerations, the effort represents an affirmation of belief in "technology for people", and a conviction that economically and ecologically acceptable high speed mass transportation represents a genuine enrichment of life and therefore one of the worth-while amenities technology has to offer.

For all these reasons, it is high time that ground transportation received the level of broad, interdisciplinary attention which is customarily lavished on the art of warfare; *it is time for a first team to take to the field.*

MIT Francis Bitter National Magnet Laboratory

Dr. Henry Kolm	leader; conceptual planning
Dr. Yuki Iwasa	electromagn., supercon.
Sumner Brown	model design, constr. testing
Charles Wallace	model fabrication
Dr. Bruce Montgomery	conceptual planning
Mathias Leupold	mech. cryo. design
Robert Weggel	electromag, mech computation

MIT Faculty

Prof. Richard Thornton	leader; concept. planning
Prof. Michael Athans	EE, control, dynamics
Prof. Eugene Covert	AE, aerodynamics, models
Prof. Charles Haldeman	AE, aero, model, ram wing
Prof. David Wormley	ME, vehicle dynamics
Prof. Myle Holley	CE, structures
Prof. John Garlanger	CE, soil mechanics
Prof. Robert Whitman	CE, structures and soil m.

AVCO Systems Division

Dr. Paul Dow	manager
Dr. Edward Sayre	tech leader, e m analysis
William Bootle	vehicle, aero, struc. analys.
William Broding	guidew., veh. structure
Dr. Peter Crimi	aerodynamic analysis
Dr. Eugene Moulic	system analys. vehicle des.
Dr. William Reinecke	test planning, evaluation
George Theophanis	magnetic testing
Dr. Marc Weinberger	control syst. analysis, syn.
Dr. Gerald Yos	mag lev theory

RAYTHEON Equipment Division

Dean Bensley	manager
Alan Greene	tech leader em control analysis
Wilfred Fordon	prop field control syst analysis
William Harrold	field and force analysis
Dr. Chien Tang	mag lev and propulsion theory
George Tucker	cyclcconv design, construction
Ephraim Weiss	em analysis, model instrumentat.

JACKSON & MORELAND

David Jackson	power distr contr switching
Fred Lindquist	guideway structure, fabrication

Internal Unpublished Reports

MIT

Static inductance simulation of mp dynamics;IWASA
Magnetic shielding for mp cabin; IWASA
Report on Japanese mag lev progress; IWASA
Design, fabrication of mp model guideway; BROWN
Aerodynamic aspects of the magneplane; COVERT
Ram wing lift contribution for the mp; HALDEMAN
The magneplane system (patent disc.) THORNT. KOLM
Preliminary design of mp cryo modules; IWASA
Control of magneplane motion; ATHANS

AVCO

General characteristics of mp vehicle; BOOTLE
Magn. lift and moment formulations; BOOTLE
Rigid body heave and pitch equations; BOOTLE
Data for feasibility of TRANSPO model; BOOTLE
Additions to mp heave, pitch equs.; BOOTLE
Forces on mp; MOZZICATO, WEINBERGER:
Simple model for lev. forces, torques; WEINBERGER
Aerodynamic loading on tracked vehicles; CRIMI
Heave motion with aeroelastic effects; BOOTLE
Size of horizontal stabilizer for mp; BOOTLE
Magnetic trim of magneplane; FLAHERTY
Dynamic response of bodies in mag lev; ROTH,PIERRO
Summary of K200 series mp studies to date; BOOTLE
Segmented mp, clarification of forces, moments; "
Force sensor calibration and mp test data; GIARA
Suggestion for mag lev prop test facility; SAYRE
Forces in LSM for mp,trav. wave model; WEINBERGER
Force experiments, coils, magnets; WEINBERGER
Formulation of mag. force eqations for mp; YOS
Linear analysis, heave/pitch motion; BOOTLE
Test report, rotating disk; THEOPHANIS
Viscous flow in magnplane-guideway gap; BOGER
Analysis of mp linear synch. motor; SAYRE

RAYTHEON

Magneplane economic tradeoffs; FORDON
Magneplane magnet calculations; HARROLD
Lift and drag force calculations, TANG, HARROLD
Guideway impedance experiments; WEISS
Cycloconverter interim report; TUCKER
Resonant freq. of small perturbations; HARROLD
Resonant freq. of pitch motion; WEISS
Instrumentation for scale model of mp; WEISS
Magneplane magnets; HARROLD
Guideway impedances; WEISS
Guideway field contour and shielding exps. WEISS
Vehicle magnetic field configuration; FORDON
Eddy current diffusion; TANG, HARROLD:
Magneplane guideway switching; GREENE, TUCKER
Lift, drag forces, layered guideways; TANG
Magneplane scale model instrumentation; WEISS
Recomm. improvements, cyclo. controls: WEISS

JACKSON & MORELAND

Magneplane power system cost studies; JACKSON
Magneplane guideway cost studies; LINDQUIST

Future Objectives

Objectives of the present effort are to perform what in the aerospace industry would be called a *concept evaluation study*, and to demonstrate the results of this study with sufficient credibility to justify a fundamental re-evaluation of present US policy in the development of high speed ground transportation. Such re-evaluation would hopefully result in adequate funding for the construction of a full scale magneplane test system, on a time scale compatible with the present schedule of tracked air cushion vehicle and linear induction motor (TACV-LIM) development, so as to permit a meaningful comparison before further decisions are made. An alternative objective is the generation of further private support, domestic or foreign, or foreign government support, to permit the continued development of magneplanes.

A further objective of the present effort is to conduct a public relations program aimed at making the concept of electromagnetic flight as familiar as that of aerodynamic flight among the engineering professions as well as the public at large. This is necessary to pave the way for public acceptance and has been grossly neglected in the past. The first step will be the making of a documentary educational film based on the operational 1/25 scale magneplane system. It will attempt to convey a feeling of adventure and participation; this is essential for the support of any innovative enterprise, from the building of the great cathedrals of Europe to walking on the moon.

Further work should concentrate on several obvious tasks: detailed attention to design of the vehicle coil system and cryogenic modules should permit substantial weight reduction and better passenger shielding; aerodynamic forces, including ram wing lift, need more attention; the linear motor and associated control systems require more detailed analysis and testing; there is room for better optimization in the power distribution and conditioning system; techniques for reducing guideway cost must be studied by applying aerospace thinking to civil engineering problems.

A reasonable next step would be the construction of an approximately half-scale magneplane system. Its vehicle would be the size of an elongated automobile, large enough to carry cryogenic coils and two passengers so as to permit subjective evaluation of ride quality. Two miles of straight guideway would suffice for initial testing and could be installed at minimum cost in almost any major airport, adjacent to a parallel taxiway. Such a project would provide valuable engineering information, and would also perform a very important public relations function in exposing the project in a highly visible manner.

Literature

J. R. Powell and G. R. Danby: The linear synchronous motor and high speed ground transport; Proc. Energy Conversion Conf., Boston Aug 3-5, 1971.

J. T. Harding: Progress in magnetic suspension applied to HSGT; Proc. 17th Annual Conf. on Magnetism and Magnetic Materials, Chicago, Nov 16-19, 1971.

Mitsubishi Electric Corporation: Fundamental study of high speed ground transp.; Company report.

Mr. LEWIS. Mr. Tabuchi, Thank you for your patience.

Mr. TABUCHI. Mr. Chairman, honorable members of the committee, distinguished guests, ladies and gentlemen, it is a great honor for me to be invited to this hearing to speak.

Mr. LEWIS. Mr. Tabuchi, speak into the microphone a little closer. Thank you.

Mr. TABUCHI. Now it is easy for me to explain what I represent after Mr. Blanchette and Dr. Kolm.

In 1963, the Japanese National Railways introduced high speed rail, 125 miles an hour train. And has operated the so-called bullet train over 23 years. Bullet train has carried over three billion passengers during this period without a single mortality.

We are very proud of this record. Presently we run approximately 220 bullet trains a day, 16 cars on each train and each car carrying about 90 passengers.

When the State of Florida initiated high speed rail talks back in 1982, the JNR was approached by the Governor, then Governor Graham, and Mr. J.P. Wright to consider our bullet train operations in Florida. We spent over 2,500 engineer days in Florida to study high speed rail project. Over $3 million has been spent for this purpose.

When it became clear that the Florida project will proceed into the 21st Century and the steel-on-steel rail concept, perception is very negative among Americans in general, Floridians in particular; and the need of faster mobility in America was learned, JNR began considering the most advanced technology, MagLev, for the Florida project.

In 1964, when we began operating the bullet train, the Japanese government organized a committee which gathered scientist, scholars, bureaucrats from the MITI, Ministry of Transport, JNR, JARTS, Japan Railway Technical Service, business representatives, to study future transportation systems for Japan.

The Japanese Government predicted that the corridor between Tokyo and Osaka, the second largest city in Japan, would require a new line and new technology to accommodate the future demand for the traffic between those two cities.

They stated that the new train must travel between Tokyo and Osaka, which is 500 kilometers or about 310 miles, in one hour. Presently, it is running a little bit less than three hours. The technology must be fuel efficient, quiet, environmentally sound, no pollution, lighter system, less maintenance cost, et cetera.

After all these factors were considered, the committee concluded that the only technology which could satisfy all these factors was the superconductivity equipped magnetic levitation technology. We knew the Germans started the research on electromagnet, which was demonstrated.

The Japanese did not believe this could satisfy the country's needs in the 21st Century.

Twenty three years later and over $700 million spent in research, we have a successful test center of superconductivity MagLev system in south Japan, maximum speed of 323 miles per hour recorded at 255 miles per hour with a man on board.

Last week a new running model was delivered which was carried on March 30 newspaper, carrying 44 passengers, 4 cars in each, trying to achieve 400 kilometers per hour, which is 250 miles per hour with 2 cars to achieve 480 kilometers which would be 300 miles per hour.

Let me explain briefly what the superconductivity magnetic levitation technology is. I will try to explain what the difference is in electromagnetic and superconductivity magnet.

The theory was found back in 1911 by a Dutch scientist. By cooling liquid helium down to minus 269 degrees we achieve absolute zero electric resistance. This is called superconductivity. Future generation computers require this type of technology for quicker information processing.

Then we charge vast amounts of electricity into our system, creating very strong magnetic force, put this L-shaped magnet on the bottom of the train, put a coil on the floor of the guideway which is not connected to any electricity.

The linear induction motor pulls and pushes our system by switching the electric current. As the system goes faster, the superconductivity magnet and the ground coil induce a magnetic field which levitates our system over four inches.

The electromagnet which does not use superconductivity like in Germany lifts one centimeter, which is 3/8 of an inch. It is very difficult to achieve over 200 miles per hour at this speed when you are carrying 20 tons in each car.

JNR spent 23 years for this research and we believe we are ready. Recent breakthroughs in the United States and in Japan on the superconductivity technology research can help our system and prove that our thinking for the future technology was right.

After 20 years of research on superconductivity and magnetic levitation, many merits of the technology and other applications are found. The Japanese Government commissioned a new study on superconductivity; that is, MagLev ship and MagLev spaceship launching technology.

Can you imagine a ship crossing oceans without fuel? Or can you imagine launching a space shuttle without explosives? How much can we save on energy? For your information, I have also brought copies of this paper which was presented to a space development conference held in Europe last October.

Let me explain briefly how magnetic levitation can launch a spaceship without rockets. We put a space shuttle on our MagLev guideway system. This requires 2.3 kilometers to launch your space shuttle without explosives.

As you know, a space shuttle system as well as other launching systems is to put humans on the top of the explosives and ignite. You cannot stop your launching process once your system is ignited. We can avert the launch even halfway through, if we find any malfunctions.

By attending the space development conference held in Atlantic City last year, I learned that MagLev system is going to be a key technology for transportation systems in the space, moon surface, et cetera. I thought this committee may wish to hear about our system today.

With these explanations, you understand that we are not just a railroad system, we are computer technology, shipbuilding technology, space development technology. We are a super speed ground transportation system.

Now I will talk about the Florida high speed rail project. Florida, with former Governor, now U.S. Senator, Graham's leadership, entered into serious thinking toward building a high speed rail system as an alternative method over airlines and automobile systems, which will run out of space and become saturated in the 21st Century.

We praise Governor Graham's leadership in this venture. If we do not have the alternative before the next century, we will be creating congested highways and air travel, repeating the mistakes California and other states made in the 1960s.

When you think future, you have to think in future terms. I do not believe railroads can revive in this country. I am very sorry to say so. Americans, with its mobility will not accept 100 mile or 200 miles per hour. Even commuter airlines run over 200 miles. The United States is too large for traditional/conventional train which takes too much time over airline travel.

The country which holds such high speed rail technology like Japan and France are 20 to 25 times smaller than the United States. It is logical for them to utilize 150-200 miles per hour, but not in the United States. Our system is capable of traveling over 300 miles per hour, maybe faster in the future.

Our system is therefore not a railroad. We are a future transportation system carrying people at the speed of jets at one-third of passenger mile fuel efficiently, no weather delays, at maybe one-half of the cost of the airline travel.

It is very strange for a person like myself, who grew with public transportation train system, to see American Federal Government and state governments stating that they will put their public money for highways, roads, seaports, airports, but when it comes to the rail system, we have to utilize private money to provide transportation system for the people of the state or visitors to the state.

Also, government leaders know that countries like Japan and France are operating high speed rail successfully.

Here in South Florida, the State of Florida plans to purchase CSX right-of-way and run a commuter system during I-95 construction. Palm Beach Country, Broward County and Dade County, plans to run tri-county commuter system. Dade County has the metro system, and the state has issued the RFP for high speed rail from Dade County to Hillsborough through Orange.

The amazing thing is that none of these projects are coordinating among themselves. It is like federal highway, state highway and county roads have no junctions or intersections. State commuter system, tri-county system, will be financed with public money. Metro system was financed by the public money. High speed rail has no public money. I do not understand this logic.

In Japan, JNR connected Tokyo and Osaka by bullet train. Private rail lines were connected to those major JNR lines, private lines were connected by small commuters, subways, buses, et cetera.

Within this network, those concerned have made a great success. It has been one big cooperative between the government and the private sector. It makes great sense to my mind. This cooperative has helped development of regions immensely. Unlike American major cities, which are connected by airlines, Japanese major cities are connected by high speed rail. Let me explain the benefits for this.

Tokyo, Nagaya, Kyoto and Osaka are called Tokaido, major corridors of Japanese business which are compared to Washington, Baltimore, Philadelphia, New York and Boston.

Along the Tokaido line, local cities grew as the region grew because they are all connected by rail on the ground.

In contrast, the northeast corridor has only benefitted major cities, Washington, D.C., New York, and Boston, and they are connected by air.

I believe states such as Maryland, Pennsylvania, New Jersey, Connecticut, Rhode Island, New Hampshire would benefit greatly if the region had a great competitive ground transportation system. Once the airline takes off at Logan or LaGuardia or National airports, no one in between cities benefit much.

Now, let me talk about Florida's corridor. I believe the corridor of Miami, Orlando, Tampa will greatly benefit by having a high speed rail system. The distance is too short for airlines.

Now what do we need for a high speed rail project in Florida?

The state is asking us to provide a public transportation system for the people of this state. Instead of the public subsidiary, the states provides some incentives to the applicants by granting some real estate development rights. What kind of real estate can pay off three to four billion capital investment? Maybe three or four more Disney Worlds can do it, which cost maybe extra $10-12 billion more.

So in order for us to be competitive in this market, we must be very, very creative in our planning. We need all the help we can get from the government, state and federal government. Without them, I do not believe it can be possible.

I hear that the Federal Railway Administration is planning to regulate MagLev technology as a railroad technology. I mentioned that it is not a railroad technology.

I understand that the railroad is the most heavily regulated industry in this country. Now as we try to provide a public transportation system so that the government does not have to spend money for it, the governments wants to regulate it and discourage our effort. I really do not understand your logic.

Rather, we need incentives from the government, such things as acquisition of right-of-way, tax-free bonds, other tax incentives, less regulations on our process so that we can be creative and less burdened by the regulations.

If the government is putting money, I understand. We are trying to follow what this Administration preaches, private initiative. I sincerely hope this government will try to assist this Florida project, which is the pioneer in privately financed public transportation system which is running on very, very thin ice.

Your help in this project may help other projects in the United States who are watching us very carefully.

Thank you very much for your attention.

Mr. Lewis. Thank you, Mr. Tabuchi.

[The prepared statement of Mr. Tabuchi follows:]

SUPER CONDUCTIVITY MAGNETIC LEVITATION SYSTEM AND FLORIDA HIGH SPEED RAIL PROJECT

PRESENTED TO
THE SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS
UNITED STATES HOUSE OF REPRESENTATIVES
ON APRIL 3, 1987

K. SAM TABUCHI
DIRECTOR
MAG-LEV FLORIDA OFFICE

MR. CHAIRMAN, HONORABLE MEMBERS OF THE COMMITTEE, DISTINGUISHED GUESTS, LADIES AND GENTLEMEN. IT IS A GREAT HONOR FOR ME TO BE INVITED TO PRESENT OUR TECHNOLOGY TO THIS DISTINGUISHED PANEL OF HOUSE MEMBERS TODAY.

IN 1964, THE JAPANESE NATIONAL RAILWAYS (JNR) INTRODUCED HIGH SPEED RAIL TO THE WORLD -- SHINKANSEN. JNR HAS OPERATED THE SHINKANSEN, SO CALLED "BULLET TRAIN" OVER 23 YEARS. THE BULLET TRAIN HAS CARRIED CLOSE TO 3 BILLION PASSENGERS DURING THIS PERIOD WITHOUT A SINGLE MORTALITY. WE ARE VERY PROUD OF THIS RECORD. PRESENTLY, WE RUN APPROXIMATELY 220 BULLET TRAINS A DAY, 16 CARS ON EACH TRAIN, AND EACH CAR CARRYING ABOUT 90 PASSENGERS. THUS, THE BULLET TRAIN IS ESTIMATED TO CARRY 316,800 PASSENGERS A DAY.

WHEN THE STATE OF FLORIDA INITIATED THE HIGH SPEED RAIL TALKS BACK IN 1982, JNR WAS APPROACHED BY THEN GOVERNOR GRAHAM AND MR. J. P. WRIGHT TO CONSIDER OUR BULLET TRAIN OPERATION IN FLORIDA. WE SPENT OVER 2500 ENGINEER DAYS IN FLORIDA TO STUDY HIGH SPEED RAIL PROJECT. OVER $3 MILLION WAS SPENT FOR THIS PURPOSE.

WHEN IT BECAME CLEAR THAT THE FLORIDA PROJECT WILL PROCEED INTO THE 21ST CENTURY; THAT THE PERCEPTION OF STEEL-ON-STEEL RAIL TECHNOLOGY WAS VERY NEGATIVE AMONG AMERICANS IN GENERAL AND FLORIDIANS IN PARTICULAR; AND THE NEED FOR FASTER MOBILITY IN AMERICA WAS LEARNED, JNR BEGAN CONSIDERING THE MOST ADVANCED TECHNOLOGY -- MAG-LEV -- FOR FLORIDA.

IN 1964, WHEN WE BEGAN OPERATING THE BULLET TRAIN, THE JAPANESE GOVERNMENT ORGANIZED A COMMITTEE WHICH GATHERED SCIENTISTS, SCHOLARS, BUREAUCRATS FROM THE MITI, THE MINISTRY

OF TRANSPORT, JNR, JARTS, AND BUSINESS REPRESENTATIVES, TO STUDY FUTURE TRANSPORTATION SYSTEMS FOR JAPAN. THE JAPANESE GOVERNMENT PREDICTED THAT THE CORRIDOR BETWEEN TOKYO AND OSAKA (THE SECOND LARGEST CITY IN JAPAN) WOULD REQUIRE A NEW LINE AND A NEW TECHNOLOGY TO ACCOMMODATE FUTURE DEMAND FOR TRAFFIC BETWEEN THOSE TWO CITIES. THEY STATED THAT THE NEW TRAIN MUST TRAVEL BETWEEN TOKYO AND OSAKA (500 KM) OVER 310 MILES IN ONE HOUR, ALTHOUGH IT CURRENTLY TOOK A LITTLE OVER THREE HOURS. THE TECHNOLOGY MUST BE FUEL EFFICIENT, QUIET, ENVIRONMENTALLY SOUND (NO POLLUTION), A LIGHTER SYSTEM, LESS MAINTENANCE COST, ETC. AFTER ALL THESE FACTORS WERE CONSIDERED, THE COMMITTEE CONCLUDED THAT THE ONLY TECHNOLOGY WHICH COULD SATISFY ALL THESE FACTORS WAS THE SUPER CONDUCTIVITY EQUIPPED MAGNETIC LEVITATION TECHNOLOGY. THE JAPANESE KNEW THE GERMANS STARTED THE RESEARCH ON ELECTRO-MAGNET MAGNETIC LEVITATION TECHNOLOGY BUT DID NOT BELIEVE THIS COULD SATISFY THE COUNTRY'S NEEDS IN THE 21ST CENTURY.

TWENTY-THREE YEARS LATER AND WITH OVER $700 MILLION IN RESEARCH EXPENDITURES, WE HAVE A SUCCESSFUL TEST CENTER OF SUPER CONDUCTIVITY MAG-LEV SYSTEM IN SOUTHERN JAPAN, WITH A MAXIMUM SPEED OF 323 MILES PER HOUR RECORDED AND 255 MILES PER HOUR WITH A MAN ON BOARD.

FORMER GOVERNOR, NOW U.S. SENATOR, BOB GRAHAM WAS THE FIRST AMERICAN RIDER ON THIS SYSTEM. ON OCTOBER 15, 1983, GOVERNOR GRAHAM RODE ON THE SYSTEM RUNNING APPROXIMATELY 200 MILES PER HOUR.

LAST WEEK, A NEW RUNNING MODEL WAS DELIVERED TO OUR SITE: 44 PASSENGERS ON EACH CAR, A TRAIN OF 4 CARS TO RUN OVER 400

KILOMETERS PER HOUR, 250 MILES PER HOUR; OR 2 CARS TO RUN OVER 480 KILOMETERS PER HOUR, 300 MILES PER HOUR. THIS SYSTEM WILL BE OPEN TO THE PUBLIC THIS SUMMER. WE ARE READY TO BUILD AN ACTUAL RUNNING SYSTEM ANYWHERE IN JAPAN, FLORIDA, OR ANYWHERE IN THE WORLD.

LET ME EXPLAIN WHAT THE SUPER CONDUCTIVITY MAGNETIC LEVITATION TECHNOLOGY IS. THE PRINCIPLE IS VERY SIMPLE. FOR YOUR INFORMATION, I HAVE BROUGHT BROCHURES ON THE TECHNOLOGY.

WE HEAR THE WORD SUPER CONDUCTIVITY VERY OFTEN NOW. IT WAS DISCOVERED BACK IN 1911 BY A DUTCH SCIENTIST.

BY COOLING LIQUID HELIUM DOWN TO -260 DEGREES CENTIGRADE, WE ACHIEVE ABSOLUTE ZERO ELECTRIC RESISTANCE. THIS IS CALLED SUPER CONDUCTIVITY. FUTURE GENERATION COMPUTERS REQUIRE THIS TYPE OF TECHNOLOGY FOR QUICKER INFORMATION PROCESSING. THEN, WE CHARGE VAST AMOUNTS OF ELECTRICITY INTO OUR SYSTEM, CREATING A VERY STRONG MAGNETIC FORCE, PUT AN L-SHAPED MAGNET ON THE BOTTOM OF THE TRAIN AND PUT A COIL ON THE FLOOR OF THE GUIDEWAY WHICH IS NOT CONNECTED TO ANY ELECTRICITY. THE LINEAR INDUCTION MOTOR PULLS AND PUSHES OUR SYSTEM BY SWITCHING THE ELECTRIC CURRENT. AS THE SYSTEM GOES FASTER, THE SUPER CONDUCTIVITY MAGNET AND THE GROUND COIL INDUCE A MAGNETIC FIELD WHICH LEVITATES OUR SYSTEM OVER 4 INCHES (10 CM).

JNR HAS SPENT 23 YEARS ON THIS RESEARCH AND WE BELIEVE WE ARE READY. RECENT BREAKTHROUGHS IN THE U.S. AND IN JAPAN ON THE SUPER CONDUCTIVITY TECHNOLOGY CAN HELP OUR SYSTEM AND PROVE THAT OUR THINKING FOR FUTURE TECHNOLOGY WAS RIGHT.

AFTER 20 YEARS OF RESEARCH ON SUPER CONDUCTIVITY AND

MAGNETIC LEVITATION, MANY MERITS OF THE TECHNOLOGY AND OTHER APPLICATIONS HAVE BEEN FOUND. THE JAPANESE GOVERNMENT COMMISSIONED A NEW STUDY ON SUPER CONDUCTIVITY: MAG-LEV SHIP AND MAG-LEV SPACESHIP LAUNCHING TECHNOLOGY.

CAN YOU IMAGINE A SHIP CROSSING OCEANS WITHOUT FUEL? CAN YOU IMAGINE LAUNCHING A SPACE SHUTTLE WITHOUT EXPLOSIVES? HOW MUCH WE CAN SAVE ON ENERGY. FOR YOUR INFORMATION, I HAVE ALSO BROUGHT COPIES OF A PAPER WHICH WAS PRESENTED TO A SPACE DEVELOPMENT CONFERENCE HELD IN EUROPE LAST OCTOBER. LET ME EXPLAIN BRIEFLY HOW MAG-LEV TECHNOLOGY CAN LAUNCH A SPACESHIP WITHOUT ROCKETS. WE PUT A SPACE SHUTTLE ON OUR MAG-LEV GUIDEWAY SYSTEM. THIS WOULD REQUIRE 2.3 MILES TO LAUNCH YOUR SPACE SHUTTLE WITHOUT EXPLOSIVES. AS YOU KNOW, A SPACE SHUTTLE SYSTEM, AS WELL AS OTHER LAUNCHING SYSTEMS, OPERATES BY PUTTING HUMANS ON TOP OF EXPLOSIVES AND IGNITING THE EXPLOSIVES. YOU CANNOT ABORT YOUR LAUNCHING PROCESS ONCE YOUR SYSTEM IS IGNITED. WITH A MAG-LEV SYSTEM, WE CAN ABORT THE LAUNCH EVEN HALFWAY THROUGH, IF WE FIND SOME MALFUNCTION IN THE SYSTEM. BY ATTENDING THE SPACE DEVELOPMENT CONFERENCE HELD AT ATLANTIC CITY LAST YEAR, I LEARNED THE MAG-LEV SYSTEM IS GOING TO BE A KEY TECHNOLOGY FOR TRANSPORTATION SYSTEMS IN SPACE, MOON SURFACE VEHICLES, ETC. I THOUGHT THIS COMMITTEE MAY WISH TO HEAR ABOUT OUR SYSTEM.

WITH THE ABOVE EXPLANATION, YOU UNDERSTAND THAT WE ARE NOT JUST A RAIL SYSTEM AND DEFINITELY NOT A RAILROAD.

WE ARE A COMPUTER TECHNOLOGY.

WE ARE A SHIPBUILDING TECHNOLOGY.

WE ARE A SPACE DEVELOPMENT TECHNOLOGY.

WE ARE A SUPER SPEED GROUND TRANSPORTATION SYSTEM.

NOW, I WILL TALK ABOUT THE FLORIDA HIGH SPEED RAIL PROJECT. FLORIDA, UNDER FORMER GOVERNOR GRAHAM'S LEADERSHIP, ENTERED INTO SERIOUS THINKING TOWARD BUILDING A HIGH SPEED RAIL SYSTEM AS AN ALTERNATIVE METHOD OVER AIRLINE AND AUTOMOBILE SYSTEMS, WHICH WILL RUN OUT OF SPACE AND BECOME SATURATED IN THE 21ST CENTURY. WE PRAISE GRAHAM'S LEADERSHIP IN THIS VENTURE. IF WE DO NOT HAVE ALTERNATIVES BEFORE THE NEXT CENTURY, WE WILL BE CREATING CONGESTED HIGHWAYS AND AIR TRAVEL, REPEATING THE MISTAKES CALIFORNIA MADE IN THE 1960'S.

WHEN YOU THINK OF THE FUTURE, YOU HAVE TO THINK IN THE TERMS OF THE FUTURE. I DO NOT BELIEVE RAILROADS CAN REVIVE IN THIS COUNTRY. I AM VERY SORRY TO SAY SO. AMERICANS WILL NOT ACCEPT 100 MILES PER HOUR, OR EVEN 200 MILES PER HOUR, WHEN EVEN COMMUTER AIRLINES ARE RUNNING OVER 200 MILES PER HOUR. THE U.S. IS TOO LARGE FOR TRADITIONAL/CONVENTIONAL TRAINS WHICH TAKE TOO MUCH MORE TIME THAN AIRLINE TRAVEL. THE COUNTRIES WHICH HOLD SUCH TECHNOLOGY, SUCH AS JAPAN AND FRANCE, ARE 20-25 TIMES SMALLER THAN THE U.S. IT IS LOGICAL FOR THEM TO UTILIZE 150-200 MILES PER HOUR, BUT NOT THE U.S. OUR SYSTEM IS CAPABLE OF TRAVELING OVER 300 MILES PER HOUR, AND MUCH HIGHER SPEEDS WILL BE POSSIBLE IN THE FUTURE. OUR SYSTEM IS NOT A RAILROAD. OUR SYSTEM IS A FUTURE TRANSPORTATION SYSTEM CARRYING PEOPLE AT THE SPEED OF JETS, AT ONE THIRD OF PASSENGER MILE FUEL EFFICIENCY, NO WEATHER DELAYS, AT PERHAPS ONE HALF OF THE COST OF AIRLINE TRAVEL.

IT IS VERY STRANGE FOR A PERSON LIKE MYSELF, WHO GREW UP WITH A PUBLIC TRANSPORTATION TRAIN SYSTEM, TO SEE THE AMERICAN FEDERAL GOVERNMENT AND STATE GOVERNMENTS STATING THAT THEY WILL UTILIZE THEIR PUBLIC MONEY FOR HIGHWAYS, ROADS, SEAPORTS, AIRPORTS, BUT WHEN IT COMES TO RAIL SYSTEM, WE MUST UTILIZE PRIVATE MONEY TO PROVIDE TRANSPORTATION SYSTEM FOR THE PEOPLE OF THE STATE, OR VISITORS TO THE STATE. ALSO, GOVERNMENT LEADERS KNOW THAT COUNTRIES LIKE JAPAN AND FRANCE ARE OPERATING HIGH SPEED RAIL SUCCESSFULLY.

IN SOUTH FLORIDA, THE STATE OF FLORIDA PLANS TO PURCHASE CSX RIGHT-OF-WAY AND RUN A COMMUTER SYSTEM DURING I-95 CONSTRUCTION. PALM BEACH COUNTY, BROWARD COUNTY AND DADE COUNTY PLAN TO RUN THE TRI-COUNTY COMMUTER SYSTEM. DADE COUNTY HAS THE METRO SYSTEM, AND THE STATE HAS ISSUED THE RFP FOR HIGH SPEED RAIL FROM DADE COUNTY TO HILLSBOROUGH COUNTY THROUGH ORANGE COUNTY. THE AMAZING THING IS THAT THESE PROJECTS ARE NOT BEING COORDINATED. IT IS AS IF FEDERAL INTERSTATE HIGHWAYS, STATE HIGHWAYS, AND COUNTY ROADS HAD NO JUNCTIONS OR INTERSECTIONS. THE STATE COMMUTER SYSTEM AND THE TRI-COUNTY SYSTEM WILL BE FINANCED WITH PUBLIC MONEY. HIGH SPEED RAIL WILL RECEIVE NO PUBLIC MONEY. I DO NOT UNDERSTAND THE LOGIC BEHIND THIS.

IN JAPAN, JNR CONNECTED TOKYO AND OSAKA BY BULLET TRAIN. PRIVATE RAIL LINES WERE CONNECTED TO THE MAJOR JNR LINES. PRIVATE RAIL LINES WERE CONNECTED BY SMALL COMMUTERS, SUBWAYS, BUSES, ETC. WITHIN THIS NETWORK, REAL ESTATE CONCERNS HAD GREAT SUCCESS. IT HAS BEEN ONE BIG COOPERATION BETWEEN THE GOVERNMENT AND THE PRIVATE SECTOR. IT MAKES GREAT SENSE TO ME. THIS COOPERATION

HAS HELPED DEVELOPMENT OF THESE REGIONS IMMENSELY. UNLIKE MAJOR AMERICAN CITIES WHICH ARE CONNECTED BY AIRLINES, MAJOR JAPANESE CITIES ARE CONNECTED BY HIGH SPEED RAIL. LET ME EXPLAIN. TOKYO, NAGAYA, KYOTO AND OSAKA ARE CALLED TOKAIDO, WHICH CAN BE COMPARED TO THE NORTHEAST CORRIDOR IN THE U.S., WASHINGTON, D.C., BALTIMORE, PHILADELPHIA, NEW YORK AND BOSTON. ALONG THE TOKAIDO CORRIDOR, LOCAL CITIES GREW AS THE REGION GREW BECAUSE THEY WERE ALL CONNECTED BY RAIL ON THE GROUND. IN CONTRAST, THE NORTHEAST CORRIDOR IN THE U.S. HAS ONLY BENEFITED MAJOR CITIES, AS THEY ARE CONNECTED BY AIR. I BELIEVE STATES SUCH AS MARYLAND, PENNSYLVANIA, NEW JERSEY, CONNECTICUT, RHODE ISLAND AND NEW HAMPSHIRE WOULD BENEFIT GREATLY IF THE REGION HAD A COMPETITIVE GROUND TRANSPORTATION SYSTEM. ONCE AN AIRPLANE TAKES OFF AT LOGAN, LAGUARDIA OR NATIONAL AIRPORT, NO ONE IN BETWEEN THESE MAJOR CITIES BENEFITS.

NOW, LET ME TALK ABOUT FLORIDA'S CORRIDOR. I BELIEVE THE CORRIDOR, MIAMI-ORLANDO-TAMPA, WILL GREATLY BENEFIT BY HAVING A HIGH SPEED RAIL SYSTEM. THE DISTANCE IS TOO SHORT FOR AIRLINE.

NOW, WHAT DO WE NEED FOR A HIGH SPEED RAIL PROJECT IN FLORIDA?

THE STATE IS ASKING US TO PROVIDE A PUBLIC TRANSPORTATION SYSTEM FOR THE PEOPLE OF FLORIDA. INSTEAD OF THE PUBLIC SUBSIDY, THE STATE WILL PROVIDE SOME INCENTIVE TO THE APPLICANTS BY GRANTING SOME REAL ESTATE DEVELOPMENT RIGHTS. WHAT KIND OF REAL ESTATE CAN PAY OFF A $3-4 BILLION CAPITAL INVESTMENT? MAYBE THREE OR FOUR MORE DISNEY WORLDS CAN DO IT, WHICH WOULD COST US AN EXTRA $10-12 BILLION. SO, IN ORDER FOR US TO BE COMPETITIVE IN THIS MARKET, WE MUST BE VERY, VERY CREATIVE IN OUR PLANNING. WE NEED ALL THE HELP WE CAN GET FROM THE GOVERNMENT -- STATE AND FEDERAL GOVERNMENT. WITHOUT THEM, I DO NOT BELIEVE IT CAN BE POSSIBLE. I HEAR THAT THE FRA IS PLANNING TO REGULATE MAG-LEV TECHNOLOGY AS A RAILROAD. I UNDERSTAND THAT THE RAILROAD IS THE MOST HEAVILY REGULATED INDUSTRY IN THIS COUNTRY. NOW, AS WE TRY TO PROVIDE A PUBLIC TRANSPORTATION SYSTEM SO THAT THE GOVERNMENT DOES NOT HAVE TO SPEND MONEY FOR IT, THE GOVERNMENT WANTS TO REGULATE IT AND DISCOURAGE OUR EFFORT. I REALLY DO NOT UNDERSTAND YOUR LOGIC. RATHER, WE NEED INCENTIVES FROM THE GOVERNMENT, SUCH AS 1) ACQUISITION OF RIGHT-OF-WAY, 2) TAX FREE BONDS, 3) OTHER TAX INCENTIVES, 4) LESS REGULATION ON OUR PROCESS SO THAT WE CAN BE CREATIVE AND LESS BURDENED BY THE REGULATIONS. IF THE GOVERNMENT WERE CONTRIBUTING FUNDING, I COULD UNDERSTAND THIS REGULATION. WE ARE TRYING TO FOLLOW WHAT THIS ADMINISTRATION PREACHES, PRIVATE INITIATIVE. I SINCERELY HOPE THIS GOVERNMENT WILL TRY TO ASSIST OUR FLORIDA PROJECT, WHICH IS A PIONEER PROJECT IN PRIVATELY FINANCED PUBLIC TRANSPORTATION SYSTEMS AND IS ALSO RUNNING ON VERY, VERY THIN ICE. YOUR HELP IN THIS PROJECT MAY HELP OTHER PROJECTS IN THE U.S. WHO ARE WATCHING US VERY CAREFULLY.

THANK YOU FOR YOUR ATTENTION.

RESUME

PERSONAL	Katsutoshi Sam Tabuchi
Address	2823 Shamrock North Tallahassee, Florida 32308 Tel. # 904/668-2153 (Home) Tel. # 904/222-2733 (Office)
Profile	Height - 5' 11 1/2", Weight 180 lbs., Age - 36 Marital Status - Married Nationality - U.S. citizen Languages - Full fluency in both English and Japanese and fair understanding of Chinese and Spanish

EDUCATION

September 1975 - May 1977	M.S. Degree in Planning, specialized in Regional and Environmental Planning. Studio Research thesis, "An Exploration of Design and Development Potential Generated by Major Public Investment", Florida State University, Department of Urban and Regional Planning, Tallahassee, Florida.
April 1969 -	B.A. Degree in Sociology, concentration in Industrial Relations. Undergraduate thesis title, "Possible Perspectives on Mankind's Future from an Urban-Sociological Point of View", RIKKO (St. Paul's) University, Tokyo, Japan.

PROFESSIONAL WORK EXPERIENCE

October 1985 - Present	Director Mag-Lev Florida Office 215 South Monroe Street - Suite 701 Tallahassee, Florida 32301
December 1980 - September 1985	Senior International Representative Section Chief, Asia Florida Department of Commerce Division of Economic Development 107 West Gaines Street Tallahassee, Florida 32301

August 1980 - December 1980	International Representative II Florida Department of Commerce Division of Economic Development
May 1980	Special Assistant to the United States Trade Representative - Ambassador Reubin Askew.
September 1979 - July 1980	International Representative I Florida Department of Commerce Division of Economic Development
September 1978 - September 1979	Research Assistant Florida Department of Commerce Division of Economic Development
August 1977 - September 1978	Graduate Research Assistant Florida Department of Commerce
December 1976 - July 1977	Graduate Research Assistant Florida Department of Administration Division of State Planning Tallahassee, Florida
June 1976 - September 1976	Planning Intern Department of Community Planning and Development City of North Miami North Miami, Florida

MISCELLANEOUS WORK EXPERIENCE

August 1973 - June 1974	Coach: Soccer Team Instructor: Judo, Karate, Volleyball, Tennis, etc. Department of Athletics Warren Wilson College Swannanoa, North Carolina
April 1970 - July 1973	Director Department of Building Maintenance Tabuchi Industry Company, Ltd. Tokyo, Japan

REFERENCES

Business and personal will be provided upon request.

Mr. Lewis. Mr. Chairman?

Mr. McCurdy. Thank you, Tom.

That is interesting testimony.

Mr. Tabuchi, and quite frankly, I happen to be one who cannot argue with some of your logic for your points and it is a very difficult balance we try to achieve in this country.

In many respects, I think there are some models that we could learn from in Japan, such as involving a meeting in international trade and development of new technologies, which is really behind a lot of the questions today about U.S. competitiveness. And I am glad to hear your testimony.

Mr. Blanchette who was here earlier, indicated that the private sector is not going to invest in R&D projects, research and development projects, and that basically they are interested more in results and the bottom line figures on a balance sheet.

How would you respond to that statement and is there a different criteria in your country?

Mr. Tabuchi. Japanese are into 21st Century thinking last 20 years, I believe. MagLev technology has been tested for last 23 years, several hundred million dollars.

This is not research which is not tested. If the Japanese engineers and the government were not sure about safety of this technology, we could not have put Governor Graham back in 1983, October 15th. We were sure, tens of thousands of people are carried by that system. The principle is very simple, as Dr. Kolm demonstrated.

After $700 million and hundreds of thousands of people, and especially in finance area where Japanese finance is getting stronger, they are willing to put government-backed technology which became privately available as of three days ago.

I have to explain. JNR, Japanese National Railways has been abolished as of April 1 this year, three days ago. They eliminated over 300,000 jobs because the government made so much red in the operation.

Bullet train, high speed rail, makes about a billion dollars a year, but rural areas which JNR National Railroad had to serve had a lot of red operations, yet the government had responsibility to provide the transportation system for the people of the country.

That was a mistake. Private sector took that and JNR could not develop any real estate along their corridors. So private sectors connected to major corridors and made money. More so private railroad industries, I mean railroad companies in Japan are one of the biggest Japanese businesses. JNR could not do it, therefore we have to provide rural rail service even though we made a lot of money in major corridors.

Mr. McCurdy. The issue is regulation which we have in this country here. Dr. Kolm.

Mr. Kolm. I would like to address that issue by saying maybe two statements for the record. One is that for any massive new technology to be developed in the future, it is going to have to be done by making it possible for the value created to provide the capital. What I mean by that is when you build something like a high speed rail system, you create value and the people who benefit from that value, the entrepreneurs, are the ones who cheerfully put up the capital if the government provides enabling legislation.

I think that is the major breakthrough in the whole Florida approach. It restores the ability of private enterprise to engage in such a venture.

As you know, earliest technological ventures were done in barns and bicycle factories. The Wright brothers did not need much subsidy but new developments have become so expensive that they have gone beyond the capability of the single private investor and therefore, a consortium of people who benefit from the value created, have to provide the capital.

You will never pay for any transportation system at the ticket office. And for that reason, ridership studies are relatively meaningless because they are based on assumptions that do not apply. You do not know what the countryside will look like after the system is built. The very act of putting a pencil dot on a map to create a station changes the whole picture.

The second statement I would like to make is, I believe that the Japanese National Railroad's approach to MagLev misses the basic point that MagLev is a freely supported system. It does not take advantage of all of the things that a magnetic levitation system can do.

It is a rigidly supported train line system that does not gain the mobility that MagLev can supply.

I think that a great deal of diligent work has been done and a great deal of money has been spent, but I do not believe it has been spent in the right directions to make something like what I call the MagnePlane system.

Mr. McCURDY. Does your system, I saw your brochure, does it have a tube in the entry way?

Mr. KOLM. It requires only a guideway which is a 120 degree trough on the bottom. The upper part of the tube is a good security system, a good way to protect again the intrusion, it is not necessary for the operation of the MagnePlane. It will probably be logical to complete the tube.

Mr. LEWIS. The gentleman from Wisconsin?

Mr. SENSENBRENNER. No questions.

Mr. LEWIS. I would like to ask you, Mr. Tabuchi, how you are progressing with your cooling for the magnetic core. Are you still using helium or are you looking at going to another cryogenic like nitrogen and using different type alloys in the core?

Mr. TABUCHI. We have not applied any other materials but helium at this present time, but recent breakthroughs in superconductivity, nitrogen, and I understand Toshiba found some high degree superconductivity of like minus 80 degrees. I heard this over the phone, so I am not sure. More breakthrough that come for superconductivity, the more benefits we will have for our technology.

Mr. McCURDY. Dr. Kolm?

Mr. KOLM. I would like to, for the record, I would like to correct the public misimpression concerning helium. I am the man who built the first field superconductive magnet when the first high field alloy was discovered. This was back in the 1950s.

Helium is not used in a refrigeration system any more than freon is used in a kitchen refrigerator. It is a closed cycle system and the cost of helium is not the relevant objection to operating at four degrees absolute. It is the energy required to produce refrigeration.

Now to refrigerate one ton of superconducting magnet to four degrees absolute requires about one kilowatt of refrigeration energy. That is about the same, we built the superconducting MagnePlane system in 1973 and 1974, and the cost or the technical problems of keeping it at four degrees were absolutely into the technological bottleneck in the whole system.

There is no question that being able to operate at 70 or 80 degrees will make things a lot easier to engineer. It will make it possible to design the force containment with more range for safety and for ease of operation, but it is not the thing that will make something previously impossible now possible or practical.

Mr. TABUCHI. Can I comment a little bit on this question? Yes, the helium is not a major part of our expenditure, refrigeration is, as Dr. Kolm said, I do not need to argue with the scientist, but as technology becomes available and cheaper our system will become cheaper. That is what I wanted to say.

Mr. LEWIS. I want to thank both of you gentlemen for your time and your testimony.

Our next panel will be Ms. Cynthia Drew, Vice President of ENTRAK Systems from Dallas, Dr. Glenn A. Burdick, Consultant, from Tarpon Springs and Mr. Raul Bravo, Florida High Speed Rail Corporation in Deerfield Beach, Florida. Dr. Burdick is the Dean of the School of Engineering at the University of South Florida.

Mr. BURDICK. Yes, sir. I have recently retired from that position. They have talked me into coming back and I will be going back this fall as a distinguished professor.

Mr. LEWIS. As you know, your full testimony will be made a part of the record, and we ask you to summarize as much as possible. Ms. Drew?

STATEMENTS OF CYNTHIA DREW, VICE PRESIDENT, ENTRAK SYSTEMS, INC., DALLAS, TX; DR. GLENN A. BURDICK, CONSULTANT, TARPON SPRINGS, FL, AND RAUL BRAVO, FLORIDA HIGH SPEED RAIL CORPORATION, DEERFIELD BEACH, FL

Ms. DREW. Thank you. Good morning. It is indeed a pleasure to submit for your review a brief summary of ENTRAK System's high speed rail technology as it pertains to the Florida franchise.

Mr. Henry Guimarin, ENTRAK's President, is unable to attend this hearing due to family circumstances, and sends his regrets. However, we will forward, within the time frame you have allowed, comprehensive details on the ENTRAK technology, its attendant testing and the patents held by ENTRAK.

My name is Cynthia Drew, and I am Vice President and Director of development for ENTRAK.

ENTRAK has assembled a blue-ribbon panel of contractors, engineers and manufacturers to respond to the Florida High Speed Rail Commission's request for proposal. Our group will be the only made-in-America wheel/rail system proposed, and for reasons of technology and construction, would also be the safest and least costly to build.

ENTRAK's FMF-101, is based on a single linear induction motor system as tested by the Federal Railroad Administration. These are electric motors with no moving parts, which create a magnetic force pushing and pulling the train down the guideway.

And here may I append by reference the Garrett Corporation's study entitled Technical Background on Linear Induction Motors contracted for by the U.S. Department of Transportation and published in 1970. I will make this available to you.

Further information on this technology can be found in the U.S. Department of Transportation's sixth and seventh reports on high speed ground transportation dated 1972 and 1973. I brought the 1972 study. The 1973 study only has a little bit of information in it.

Propulsion for this system is provided by a 400 horsepower linear induction motor attached to the bottom of each truck or wheel set, with a reaction rail embedded in the center of an at-grade slab base.

The system will operate on 8-foot gauge track and is capable of sustained speeds of 200 miles per hour. A 20-foot wheel base and two suspension systems, to be built by Pullman, a division of Trinity Industries, will ensure stability and ride quality for our system's passengers.

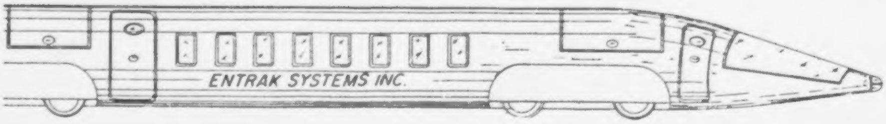
Our FMF-101 system will be completely enclosed for reasons of safety and as a weather barrier and will have two tracks, dedicated, north and west bound on one track, and east and south on the other.

We believe our system, the newest, fastest, most economical and best of all a made-in-America technology, to be a superior solution to the transportation needs of the State of Florida. I will make available to guests here the information which you should find attached to your copies of this statement and we will be contacting you in the near future to set a date and time to present in detail our visuals and full technical data.

Thank you for your time and indulgence, and I will attempt to answer any questions you may have.

Mr. Lewis. Thank you, Ms. Drew.

[The prepared statement of Ms. Drew follows:]


ENTRAK SYSTEMS INC.

April 1, 1987

Dave McCurdy, Chairman
Tom Lewis, Representative
Distinguished Members and Staff
U.S. House of Representatives
Committee on Science, Space and Technology
Subcommittee on Transportation, Aviation and Materials

Re: Field Hearing on High Speed Rail Technology
West Palm Beach, Florida
April 3, 1987

It is indeed a pleasure to submit for your review a brief summary of ENTRAK System's high speed rail technology, as it pertains to the Florida franchise.

Mr. Henry Guimarin, ENTRAK's President, is unable to attend this hearing due to family circumstances, and sends his regrets; however we will forward, within the time frame you have allowed, comprehensive details on the ENTRAK technology, the attendant testing, and the patents held by ENTRAK.

ENTRAK has assembled a blue-ribbon joint venture group of contractors, engineers and manufacturers to respond to the Florida High Speed Rail Commission's request for proposal. Our group will be the only Made-in-America wheel/rail system proposed, and for reasons of technology and construction would also be the safest and least costly to build.

ENTRAK's FMF-101 is based on a single linear induction motor system as tested by the Federal Railroad Administration. These are electric motors with no moving parts, which create magnetic forces pushing and pulling the train down the guideway.

Propulsion is provided by a 400 horse power linear induction motor attached to the bottom of each truck or wheel set, with a reaction rail embedded in the center of an at-grade slab base. The system will operate on 8 foot gauge track

4514 COLE AVENUE, SUITE 1000 DALLAS, TEXAS 75205 (214) 521-1224

and is capable of sustained speeds of 200 mph. A 10 foot wheelbase and two suspension systems, to be built by Pullman, a division of Trinity Industries, will ensure stability and ride quality for our system's passengers. Our FMF-101 System will be completely enclosed for reasons of safety and as a weather barrier, and will have two tracks, dedicated north and west bound on one track, and east and south bound on the other.

We believe our system - the newest, fastest, safest, most economical, and best of all a Made In America technology - to be a superior solution to the transportation needs of the state of Florida. We will make available to the public copies of the information which you should find attached to this statement, and we will be contacting you in the near future to set a date and time to present in detail our visuals and full technical data.

Sincerely,

Henry L. Guimarin
President

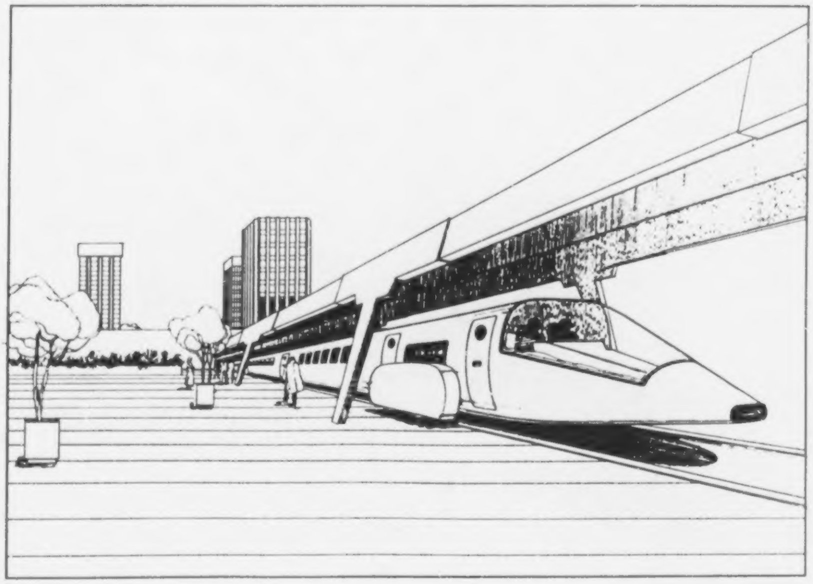
Cynthia Drew

Cynthia Drew
Vice President

ENTRAK — FMF101
200 mph Enclosed High Speed Train

ENTRAK Systems

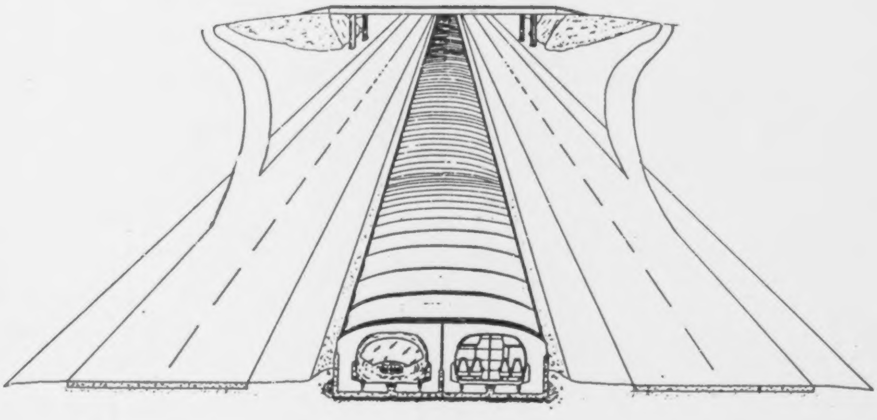
Dallas, Texas



High speed is an aspect of transportation upon which a large segment of the community places great value. It is of interest to note, in this connection, that man has often used the increases in speed achieved during this century to increase the range over which he travels, rather than to decrease the time he spends travelling. The average time people take to commute to work has not changed appreciably over the past fifty years, but the average distance commuted has increased considerably. Where the choice has existed between transportation modes offering markedly different speeds between the same points, other factors being about equal, a major share of the passenger transport business has gone to the mode offering higher speed.

The ENTRAK System represents twenty years of research and development in the field of high speed railway technology. A leading aspect of the System is its ability to handle daily trips of 314 miles at speeds of up to 200 mph, utilizing primarily existing state highway medians. Given that stations are centrally situated in cities and towns, such a system offers greatly reduced journey times from city center to city center.

The general communities in which the terminals are to be located were established as part of the definition of the scope of work for this project. They are: Miami, Fort Lauderdale, West Palm Beach, Orlando and Tampa Bay. At this time it is not practical to select specific sites, mainly because of property acquisition considerations. The terminal locations will be selected with convenience to passengers in commute time to the terminal and parking facilities.

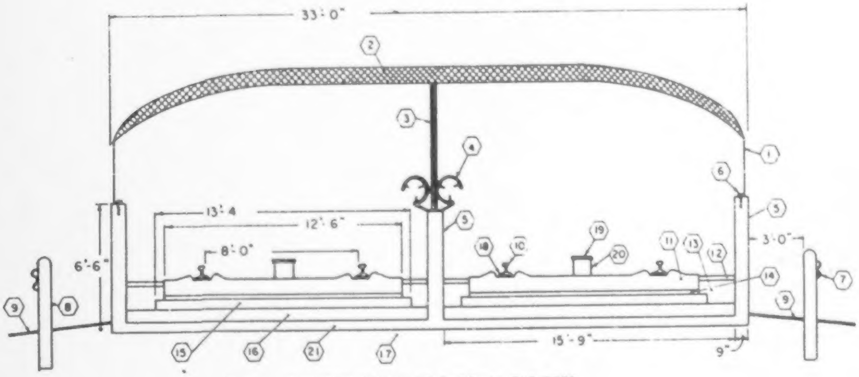


ENTRAK CONCEPT

The ENTRAK FMF101 High Speed Train combines the latest technologies of the 1980's to produce the newest and fastest of high speed trains.

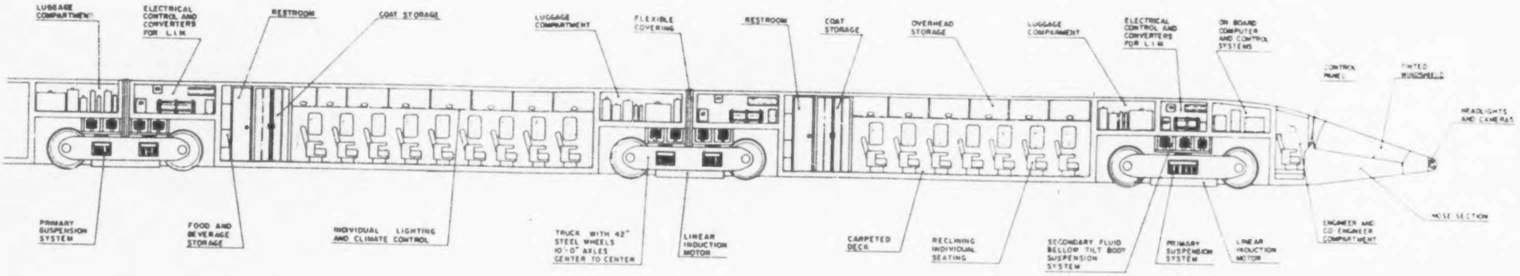
FMF101, through development and testing by ENTRAK engineers and joint venture companies, is a train set with an aerodynamic lead and rear car, only 7'-3" high, creating a low profile and a small cross-section, reducing drag and necessary horse power, and is capable of a sustained speed of 200 mph.

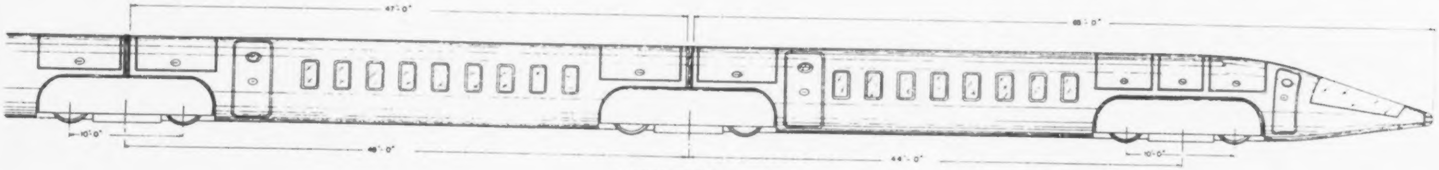
To ensure stability at high speeds, the trucks are designed with a wheelbase of 10'0" and an 8'0" rail gauge. A primary spring suspension adds ride quality, and a secondary hydraulic air bellow and hydraulic shock suspension produce a tilt body mechanism to allow up to a 6 degree incline on curves. The guideway can also be inclined up to 6 degrees. The tilt body system produces a consistently high speed through the curves.



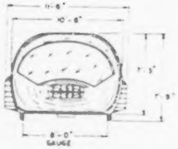
AT GRADE SECTION OF GUIDEWAY ENCLOSED

1	CORRUGATED STEEL COVER (DETAIL S-3)	12	BITUMEN GRAVEL (4")
2	CYCLONE WIRE (DETAIL S-4)	13	GRAVEL FILLER (12½")
3	4" STEEL POLE (DETAIL S-2)	14	LEVELLING AND FILLER CONCRETE NN 100 (1½")
4	ELECTRICAL WAYSIDE POWER RAIL (DETAIL E-2)	15	COMPOUND CONCRETE (8")
5	REINFORCED CONCRETE WALL	16	CEMENT BASE (6")
6	BOLT WITH SEALING RING	17	COMPACT FILL
7	CORRUGATED STEEL GUARD RAIL	18	RAIL FASTENING (DETAIL G-8)
8	8' WOOD POST (DETAIL S-1)	19	L.I.M. REACTION RAIL
9	ASPHALT PAVING	20	REINFORCED CONCRETE (DETAIL E-2)
10	135# RAIL	21	REINFORCED CONCRETE BASE (4")
11	CONCRETE SLEEPER		


LUGGAGE COMPARTMENT
ELECTRICAL CONTROL AND CONVERTERS FOR L.I.M.
RESTROOM
COAT STORAGE
LUGGAGE COMPARTMENT
FLEXIBLE COVERING
RESTROOM
COAT STORAGE
OVERHEAD STORAGE
LUGGAGE COMPARTMENT
ELECTRICAL CONTROL AND CONVERTERS FOR L.I.M.
ON BOARD COMPUTER AND CONTROL SYSTEMS
CONTROL PANEL
TINTED WINDSHIELD
HEADLIGHTS AND CAMERAS
PRIMARY SUSPENSION SYSTEM
FOOD AND BEVERAGE STORAGE
INDIVIDUAL LIGHTING AND CLIMATE CONTROL
TRUCK WITH 42" STEEL WHEELS 10'-0" AXLES CENTER TO CENTER
LINEAR INDUCTION MOTOR
CARPETED DECK
RECLINING INDIVIDUAL SEATING
SECONDARY FLUID BELLOW TILT BODY SUSPENSION SYSTEM
PRIMARY SUSPENSION SYSTEM
LINEAR INDUCTION MOTOR
ENGINEER AND CO-ENGINEER COMPARTMENT
NOSE SECTION


47'-0"
65'-0"
10'-0"
48'-0"
44'-0"
10'-0"

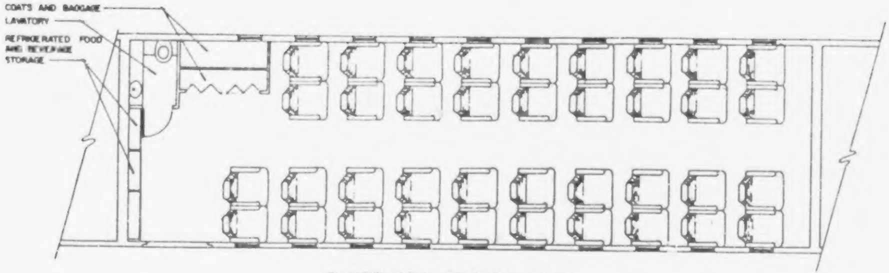
ENTRAK FMF 101


11'-6"
10'-8"
7'-3"
7'-9"
8'-0"
GAUGE

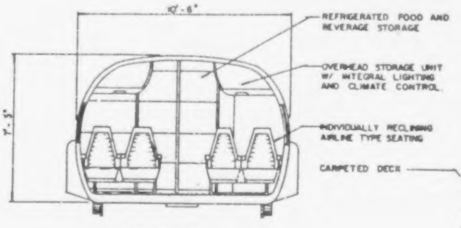
GENERAL DATA

Country	U.S.A.
Car Truck Builder	Pullman
Operational Status	Experimental
Operational Authority	ENTRAK
Nature of Operation	Test
Operational Speed	200 mph
Maximum Speed	200 mph
Energy Source	Electric
Train Capacity	364
Train Consist	11 cars
Distribution	3 phase rail
Traffic Mix on System	Freight/Passenger
Maximum System Grade	8%
Typical Train Seating	2 + 2
System Power Distribution	8,200 VAC
Track Gauge	8'0"

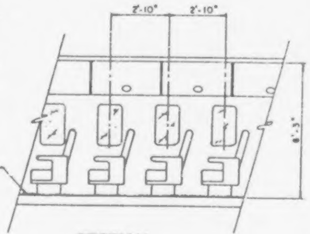
Power Pickup	Sliding Collector Arm
Vehicle Length	65' and 48'
Weight (max.)	21 tons
Vehicle Width	11'6"
Vehicle Height	7' 3"
Truck Centers	48'
Minimum Curve Radius	328'
Car Construction	Aluminum
Car Strength Requirements	460,000#
Wheel Size	42"
Weight Per Person	825 lbs.
Train Power Rating	4,800 H.P.
Consists Flexibility	Fixed
Braking System	Dyn./Disc
Suspension System	Coil/Air Spring


COATS AND BAGGAGE
LAVATORY
REFRIGERATED FOOD AND BEVERAGE STORAGE

PASSENGER SECTION PLAN
SCALE 3/8" = 1'-0"


10'-6"
7'-3"
REFRIGERATED FOOD AND BEVERAGE STORAGE
OVERHEAD STORAGE UNIT W/ INTEGRAL LIGHTING AND CLIMATE CONTROL
INDIVIDUALLY RECLINING AIRLINE TYPE SEATING
CARPETED DECK

SECTION



SECTION

At ENTRAK Systems, safety is our main consideration; it is axiomatic that any mode of transportation to be introduced should provide safety equal to or better than the best of the existing modes. While actual safety is essential, additionally, the psychological impression of safety is important for public acceptance.

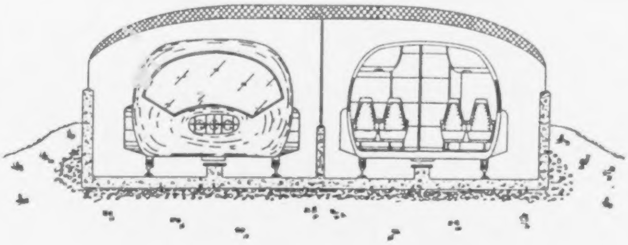
To ensure sufficient seating for all ENTRAK passengers, as well as for safety and comfort, we will require reserved seating in advance, and no standing will be allowed. The advantage of advance booking is that passengers can choose between window and aisle seats, and between smoking and nonsmoking areas. Each car features individual reclining airline type seating with seatbelts; lavatories, overhead storage and additional hangup coat and baggage compartments, individual lighting and climate control, and refrigerated food and beverage storage. All cars will have considerations for the handicapped. Cars will be air-conditioned and sound proofed and each car will have a passenger attendant.

Tracks will be dedicated north and west bound, or east and south bound to reduce switching, and for increased safety. Trainsets will be rotated at each end of a run.

The propulsion system is provided by a 400 horse power linear induction motor attached to the bottom of each truck. These are electric motors with no moving parts which create magnetic forces pushing and pulling the train down the guideway. Applying 8,200 volts of polyphase AC power to the primary windings will induce currents in the short circuited secondary, and will produce a thrust with a non-electrified aluminum reaction rail embedded in the guideway.

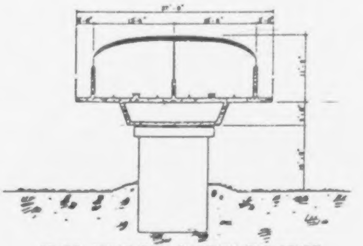
Aerodynamic, hydraulic spoilers, similar to flaps on aircraft, attached to all car bodies, produce an air brake, in addition to a dynamic electric brake created by reversing the magnetic fields of the linear induction motors. The effect of these braking systems fade at lower speeds and a friction disc brake allows for the final stop and parking.

The train line operates in a completely enclosed system comprised of a slab base, continuous, welded rails of 8'-0" gauge on resilient pads bolted to the concrete base, and a corrugated steel cover. The cover provides a barrier to weather and obstacles on the tracks, and creates a bleed-off system that allows air to be released from around the vechicle, reducing compressed air drag.



SECTION THRU GUIDEWAY ENCLOSURE

The enclosed, at-grade, system can be safely located down existing highway medians, eliminating the cost of acquiring new property, and is less costly to construct. A small portion of the system will be elevated in congested areas around stations. Other systems, elevated at bridges and overpasses and utilizing new right-of-way, can be hazardous and cost three times the amount to build.



GRADE SEPARATED GUIDEWAY ENCLOSURE

Mr. **Lewis**. Mr. Bravo.

Mr. **Bravo**. Thank you, Mr. Lewis.

Mr. Chairman, members of the committee, in behalf of the Florida High Speed Rail Corporation, we truly appreciate the opportunity to participate in discussions related to high speed rail technology. We hope that our views, as well as those of our colleagues will help to bring high speed rail to a reality in the U.S.

Increasing problems with highway and air passenger transportation systems in the U.S., compared to the success of rail services in Europe and Japan have renewed the interest in high speed rail in the U.S.

For the past several years we have heard and some of us even participated in projects in Michigan, Pennsylvania, California, New York, Ohio, Texas and, of course, Florida. Contrary to what many skeptics believe, high speed rail is coming to the U.S.

However, we must be realistic. In order to implement a successful system, we must first answer some fundamental questions. During the next ten minutes, I will attempt to answer some of those questions.

I would like to move—we have some viewgraphs. If I speak loud enough can everybody hear me?

The Florida High Speed Rail Corporation is a corporation recently formed for the purpose of responding to the request for proposal released by the Florida High Speed Rail Commission for a high speed rail system in the State of Florida.

The questions that I was referring to are these: What is high speed rail? What is the demand for high speed rail? What is the role of high speed rail in the U.S.? Do we need to develop new technologies? Do we need public help to do it?

The first question, what is high speed rail? It is simply a passenger transportation system capable of providing services competitive with other transportation modes. To be competitive, high speed rail must offer comparable trip times and be cost-effective.

Just to set the tone, in order to clarify what I mean by cost-effective, typically a train capable of speeds of 130 to 150 miles per hour could make the trip between, let us say, Miami and Tampa, in approximately two hours and 45 minutes.

The cost of building that system would be approximately $1.8 billion. A train capable of speeds of 180 miles an hour would make the same trip in approximately two hours 15 minutes, at a cost of approximately $3.2 billion. Therefore, 30 minutes could be saved at a cost of about $45 million a minute.

What is the demand for high speed rail? Unlike other countries in the world, the U.S. has highly developed highway and air transportation systems. Both of them today carry over 97 percent of the total travel market. However, in some congested corridors a reliable rail service can capture a much greater share of that market.

So what is the point or what is the role of high speed rail? The role of high speed rail is to complement the existing air and transportation system. It is not to replace the systems.

We have made—this country has made a significant investment in highways and airports over many, many years and we are not going to abandon that. We have to reduce the demands on our systems, not replace them.

Earlier we talked about the automobile. We are not going to take the people out of the automobile. They are going to help them to travel better, but we are not going to replace the automobile.

Having answered some of those fundamental questions, how do we implement the high speed rail system. I think that the economic parameters and fiscal constraints will dictate an evolutionary approach. This approach will have to be done in a manner that we can go to Wall Street and obtain the capital necessary to build a system.

Three corridors with clearly defined needs have already recommended this approach. New York City and Boston, perhaps one of the highest problem corridors in the U.S. today with no high speed rail system—they have recently recommended that evolutionary approach.

Let us walk before we start running. Michigan DOT, the same thing with them. Detroit-Chicago, California, after failure of the proposed project by the American High Speed Rail Corporation, they are now going back and rethinking and proposing the evolutionary process that is so fundamental.

And now we get to the subject of today's meeting—technology. Do we need to develop new technology in the U.S. to satisfy that demand? The answer is absolutely not. We have systems already developed in Europe and in Japan and we can learn from that.

The Florida High Speed Rail Corporation is in a rather unique position today. Our plan is not driven by technology. Technology is simply one of the components of the system so we are involving every possible technology and we will implement the one that we can afford, that the state can afford, that this country can afford.

Proven systems operate today in Sweden, Germany, France and Japan and some components are produced in Italy, Spain, England and Australia. This is an artist's rendering of a recent development in Sweden.

State of the art technology, there is another rendering of the turbo-hydraulic high speed train in France and in the U.S., I might say. Germany's ICE train is another of those examples. And last but not least the MagLev technology.

With regard to motive power options, everything from diesel engines to electrodynamic and electromagnetic technology; with regard to passenger options, we have tilting bogies, particular systems that would help us to meet the economic parameters we need to meet.

How do we go about selecting the technology? The technology that will match the demands of the markets, the technology that will match the economic parameters. We have to look at the market demand, we have to look at the suitability of the physical plant, and we have to look at how much we can afford. We have to look at the suitability of that technology to U.S. operating environment; and last but not least, safety.

With regard to the U.S. operating environment, I heard today some very good remarks regarding technology developing in other countries and whether we can use the technology in the U.S.

I think we can but we have to make adjustments. We have developed in this country a system which has proven to be one of the safest in the world. We have to pick out the technology that we can bring to this country and integrate into existing transportation systems to provide a thorough network. We cannot think in terms of bringing one train to run from A to B in a totally isolated manner.

As I said before, we have an infrastructure, we have an investment that we cannot abandon. Therefore, we need to integrate whatever we bring to this country into those systems.

Safety is one of those issues. In order to be successful, the technology must be compatible with existing systems. The design and construction standards must comply with those established by the Association of American Railroads and the Federal Railway Administration. They were developed many years ago, but they have proven to be very good and very successful.

Specifically in the area of technology, we are talking about the strength of the car body, the strength and some requirements regarding attachment of the bogies to the car body and the loads accepted at both ends of the car.

I hesitate to show this, but I think I need to. That is a recent Amtrak accident in Maryland. The manner in which you see the cars in this sketch above indicate how well those standards have worked, and we cannot abandon that.

The couplers kept the cars together and none of them rolled over, which was the function intended by the couplers. The strength of the car bodies kept those cars behind almost intact. Had this accident happened using other standards, I hate to think what the consequences would have been, but dramatically different.

Do we need public support? Yes, we do. Developing high speed rail technology, as I said before, is unnecessary. We have the technology already available. What we need to do is to select those technologies and to adapt those technologies to the needs of the market.

Areas to be looked at, for instance, control systems, bogis and suspension systems, grade crossings, warnings and protection systems and safety issues. As I said before, some of the safety rules that we are using today were developed 50 years ago. They need to be updated and we need to work on those safety rules.

With regard to grade crossing protection systems, that is a difficult issue. Earlier we said that the government needs to participate in that area and I agree 100 percent. Mr. Blanchette said that we do not have to have or we should not have grade crossings. I agree 100 percent with that statement, but we need help, we need help with all those issues.

Right now for a private venture to deal with those issues would cost over 60 percent of the total cost of the project, to deal with grade separation. In a $3 billion project, we are talking about over $1.5 billion to deal with that.

Back in the late 1970s, the Federal Railroad Administration released the improved passenger equipment evaluation program report. I think it was an excellent document and I think we need to ask the FRA to continue helping us with investigating other areas, to update that work and continue to help us in that area.

We at Florida High Speed Rail Corporation are ready to work with the private industry and with the government, with the public, in a system that will be economically feasible.

We are trying to keep our feet to the ground, we cannot invest in research and development that is not here yet, that is not running. We must remember that we must go to Wall Street to obtain capital to build this system and that is going to be the biggest problem that we are going to have to undertake.

Thank you.

[The prepared statement of Mr. Bravo follows:]

FLORIDA HIGH SPEED RAIL
CORPORATION

SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

FIELD HEARING

HIGH SPEED RAIL TECHNOLOGY

April 3, 1987

WEST PALM BEACH, FLORIDA

Presented by:

RAUL V. BRAVO
Transportation Technology

Hillsboro Executive Center 700 W. Hillsboro Blvd. Building #1 Suite 101 Deerfield Beach, FL 33441
305/429-0769

SUBCOMMITTEE ON TRANSPORTATION, AVIATION AND MATERIALS
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

FIELD HEARING
HIGH SPEED RAIL TECHNOLOGY
April 3, 1987
WEST PALM BEACH, FLORIDA

In behalf of the Florida High Speed Rail Corporation, we truly appreciate this opportunity to participate in discussions related to high speed rail technology. We hope that our views, as well as those of our colleagues, help to bring high speed rail to reality in our country.

The renewed interest on high speed rail passenger transportation can be attributed to two major factors, namely:

- Increasing problems with highway and air systems in the U.S.
- The success of rail passenger services in Europe and Japan.

For the past several years we have heard, and some of us even participated in projects in Michigan, Pennsylvania, California, New York, Ohio, Texas and, of course, Florida. In many cases, the idea is to build entirely new systems, including new right-of-ways, while in others the idea is to improve existing systems or use existing facilities.

In any case, realistic market demand estimates and financial viability will be the deciding factors and determine the type of system best suited for each location. At the same time, it will be critically important to assure that the new systems, while technologically advanced to state-of-the-art conditions, be compatible with existing rail facilities, and fully integrated into the total transportation network.

Contrary to what many skeptics believe, high speed rail will soon be a reality in the United States. However, in order to implement a succesful system, we must first answer some fundamental questions.

They are:

- WHAT IS HIGH SPEED RAIL?
- WHAT IS THE DEMAND FOR HIGH SPEED RAIL?
- WHAT IS THE ROLE OF HIGH SPEED RAIL IN THE UNITED STATES?
- DO WE NEED TO DEVELOP NEW TECHNOLOGY?
- DO WE NEED PUBLIC SUPPORT?

WHAT IS HIGH SPEED RAIL?

- A PASSENGER TRANSPORTATION SYSTEM CAPABLE OF PROVIDING SERVICES COMPETITIVE WITH OTHER TRANSPORTATION MODES
- TO BE COMPETITIVE, HIGH SPEED RAIL MUST:
  ... OFFER RELIABLE SERVICES
  ... OFFER COMPARABLE TRIP TIMES
  ... BE COST EFFECTIVE

FLORIDA HIGH SPEED RAIL
CORPORATION

These three conditions are critical. We must find the proper balance between them, otherwise the system will be doomed from the beginning. For instance, the technology must be properly selected to match the market needs and the physical constraints. If we choose technology incapable of providing competitive trip times, we may not be able to capture the market share of travellers necessary to bring sufficient revenues.

On the other hand, if we choose technology of high maximun speeds and therefore potentially capable of offering shorter trip times, the high level of capital fund requirements may affect the economic feasibility of the project. Furthermore, ridership gains due to shorter trip times may not be sufficient to sustain higher maintenance and operating costs.

This condition can be described as follows:

THE COST OF SAVING TIME

- TYPICALLY, A TRAIN CAPABLE OF SPEEDS OF 130/150 MPH COULD MAKE THE TRIP BTEWEEN MIAMI AND TAMPA IN APPROXIMATELY 2H. 45MIN.
  THE COST OF BUILDING THE SYSTEM WOULD BE ABOUT $ 1.8 BILLION.

- A TRAIN CAPABLE OF SPEEDS OF 180 MPH WOULD MAKE THE SAME TRIP IN APPROXIMATELY 2H. 15 MIN.
  THE COST OF BUILDING THE SYSTEM WOULD BE ABOUT $ 3.2 BILLION.

- THEREFORE, 30 MINUTES COULD BE SAVED AT A COST OF $ 45 MILLION PER MINUTE.

FLORIDA HIGH SPEED RAIL
CORPORATION

Why the difference in cost? -In order to fully utilize the high speed capabilities of a train designed for 180 MPH, the radii of the curves will have to be in the order of 20,000´. Further, if we assume the use of existing right-of-ways, the need for additional land will be significant and in many cases almost impossible to obtain, specially in congested areas.

Also, in order to utilize the train´s full speed capabilities, the system will need to have a minimun of two tracks, regardless of market demands and cost considerations, thereby increasing the capital fund needs at the early stages of implementation.

Higher operating speeds also means higher infrastructure costs, due to closer tolerances, as well as higher signal, comunications and control systems costs.

Because of the speed, the system will have to be fully separated. While we recognize the importance and desireability of grade separations, it is conceivable that during the initial years of operation some limited grade crossings may have to be accepted mainly due to economic constraints. Train operation at crossings should only be achieved at reduced speeds and under the most strict control and safety parameters.

WHAT IS THE ROLE OF HIGH SPEED RAIL?

- COMPLEMENT EXISTING AIR AND GROUND TRANSPORTATION SYSTEMS.
- REDUCE DEMANDS ON AIR AND HIGHWAY SYSTEMS.
- REACH AREAS BETWEEN MAIN ORIGIN AND DESTINATION POINTS.

Realistically, the large investment made on highways and airports over the last three decades, can not be abandoned.

In addition, the flexibility provided by the automobile and the service industry designed around it and for it, will continue to to make this a dominant mode. Only when the rail mode demonstrate its realibility and convenience of services, the choice will begin to shift.

Having answered some of the fundamental questions, how do we approach the implementation phase?

HOW DO WE IMPLEMENT A HIGH SPEED RAIL SYSTEM?

- ECONOMIC PARAMETERS AND PHYSICAL CONSTRAINTS WILL DICTATE AN EVOLUTIONARY APPROACH, USING PROVEN TECHNOLOGY AND EXISTING FACILITIES TO THE MAXIMUN EXTENT POSSIBLE.
- THIS APPROACH WILL MINIMIZE RISKS, LEND CREDIBILITY AND ENHANCE INVESTOR'S CONFIDENCE.
- THREE CORRIDORS WITH CLEARLY DEFINED NEEDS, HAVE ALREADY RECOMMENDED THIS APPROACH. THEY ARE:

- CONEG	NEW YORK-BOSTON
- MICHIGAN DOT	DETROIT-CHICAGO
- CALTRANS	SAN DIEGO-LOS ANGELES

... AND OF COURSE WE IN FLORIDA INTEND TO FOLLOW THAT APPROACH.

TECHNOLOGY

Q: - DO WE NEED TO DEVELOP NEW TECHNOLOGY FROM THE GROUND UP IN THE UNITED STATES?

A: - ABSOLUTELY NOT! FULLY DEVELOPED STATE-OF-THE-ART TECHNOLOGY IS ALREADY AVAILABLE. WE DO NOT NEED TO RE-INVENT THE WHEEL.

PROVEN STEEL WHEEL OR MAGNETICALLY LEVITATED TECHNOLOGY IS OPERATED OR BEING TESTED IN:

- Sweden
- Germany
- France
- Japan

... AND PROVEN COMPONENTS ARE AVAILABLE IN:

- Italy
- England
- Switzerland
- Finnland
- Spain
- Australia
- Canada

MOTIVE POWER OPTIONS

- Electric
- Gas Turbine
- Diesel-Electric
- Electro-dynamic and Electro-magnetic levitation (MAGLEV)

PASSENGER CAR OPTIONS

- Tilting bogies
- Articulated consists

With regard to motive power options, latest developments in micro-processor control technology provides the industry with new tools to enhance the performance of propulsion plants such as electric units. Even conventional diesel engines benefit from these technological advances.

Higher performance gas turbines have also reached an advanced degree of development, providing higher speeds and improved fuel consumption.

The electro-dynamic technology developed by the japanese to propell magnetically levitated vehicles, will also be dramatically benefited by the latest developments in superconductivity.

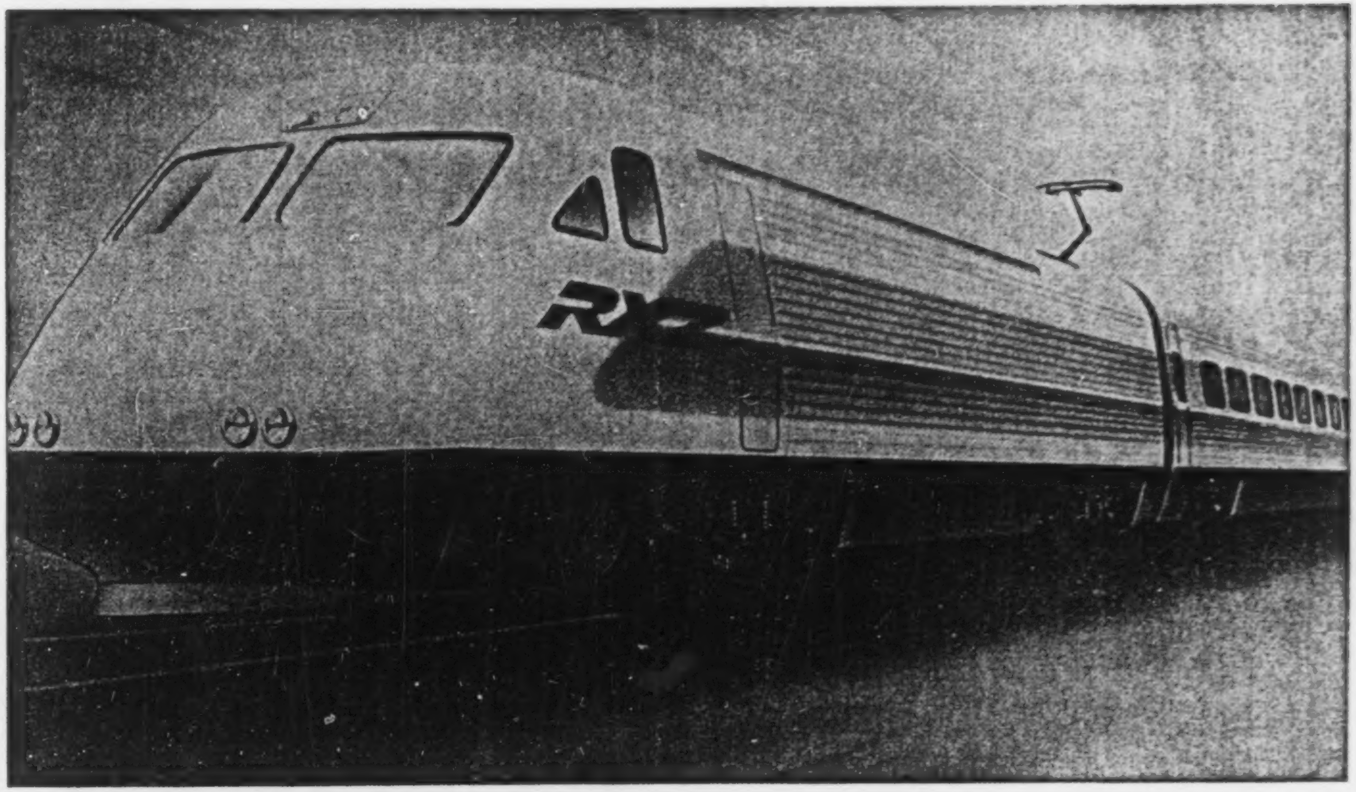
With regard to passenger cars, one of the most significant developments is the tilting mechanism which permits trains to move through curves at speeds 30 percent higher than conventional systems. This feature is especially important when site constraints and/or economic parameters prevents the alignment from having large radii curves.

These developments are the result of extensive research programs and are all available for application in the United States. Properly adapted to the needs and requirements of the local operating environments, these technologies are capable to provide the transportation services in accordance with realistic market demands, and satisfy capacity for the next several decades.

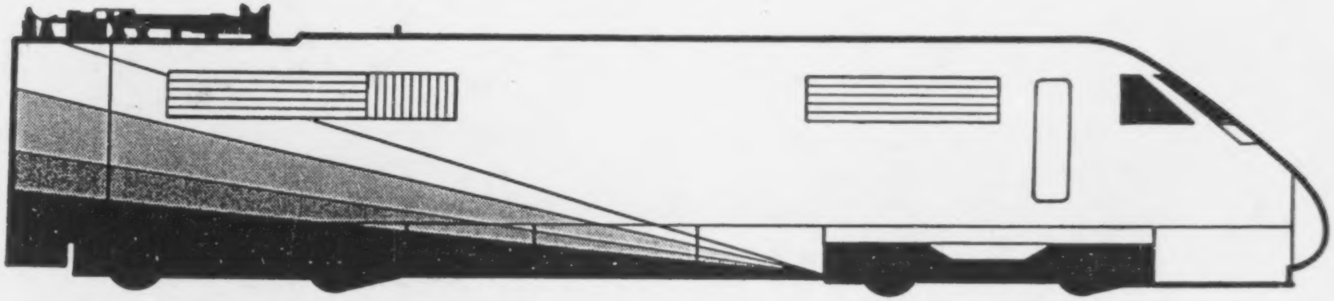
Research and development of new technology is therefore unnecessary. We must set other priorities and utilize our limited resources efficiently.

The plan proposed by the Florida High Speed Rail Corporation is for a total transportation system where technology is one important component. The plan and ultimate goals are not driven by technology alone. The plan is a balanced one with each component consistent with the whole.

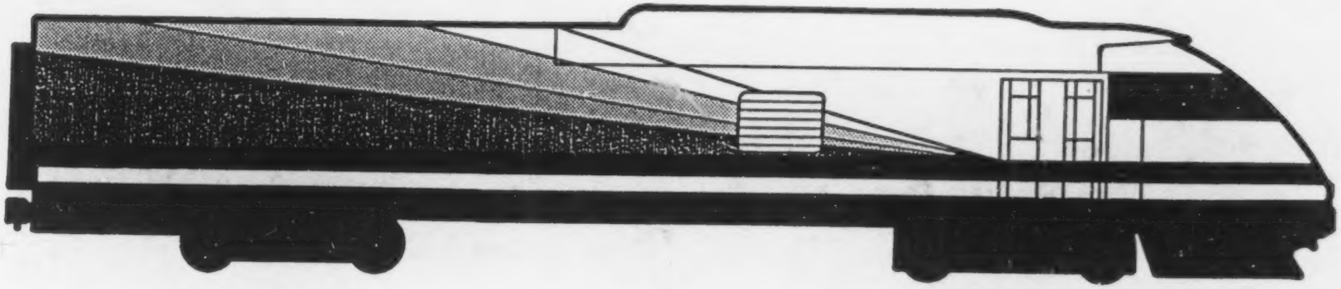
This situation places the Corporation in the unique position of not having to compromise the success of the project by trying to accomodate a given technology. FHSRC has established parameters and criteria and is in the process of evaluating several options. FHSRC will select the right technology for the project and will advice this Committee of its decision.



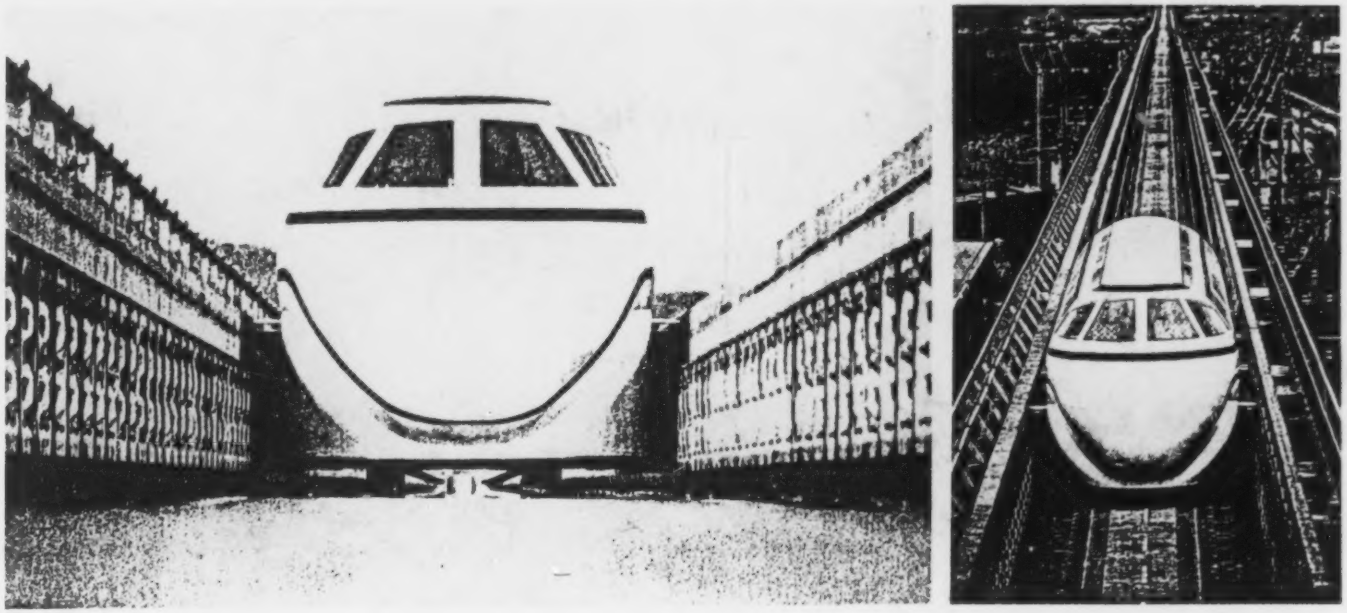
Swedish State Railways' High Speed Train



Germany's "ICE" High Speed Train



France's Turbo-Hydraulic High Speed Train



Japanese National Railways' MAGLEV -

TECHNOLOGY SELECTION CRITERIA

- Suitability to market demand
- Suitability to physical plant
- Affordability
- Suitability to U.S. operating environment
- Safety

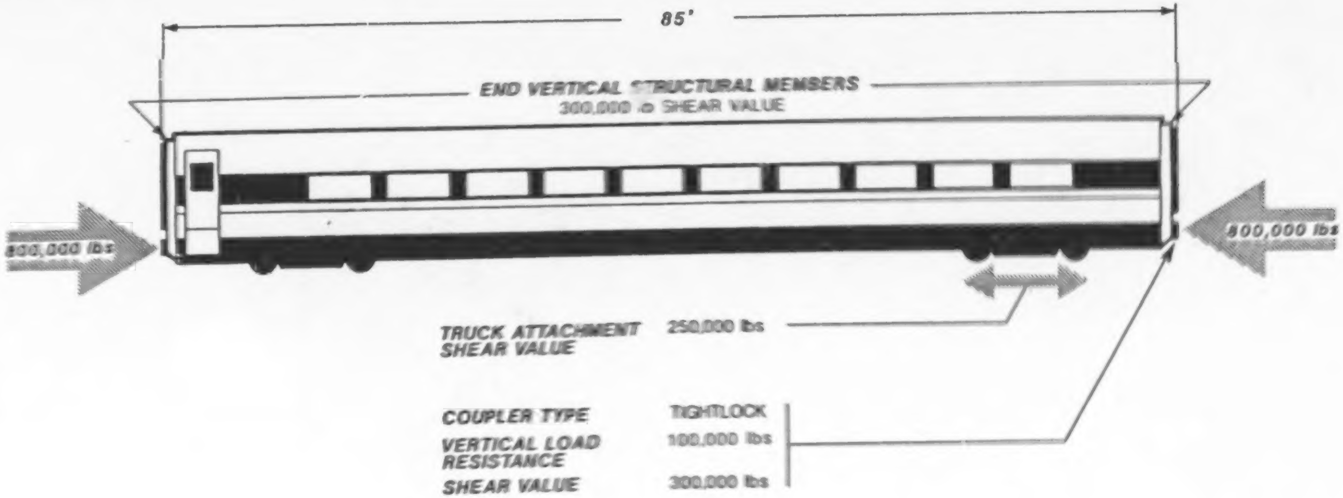
REGARDING SAFETY:

- o In order for the system to be succesful, the technology chosen must be capable of interfacing and integrating with existing steel wheel technology.

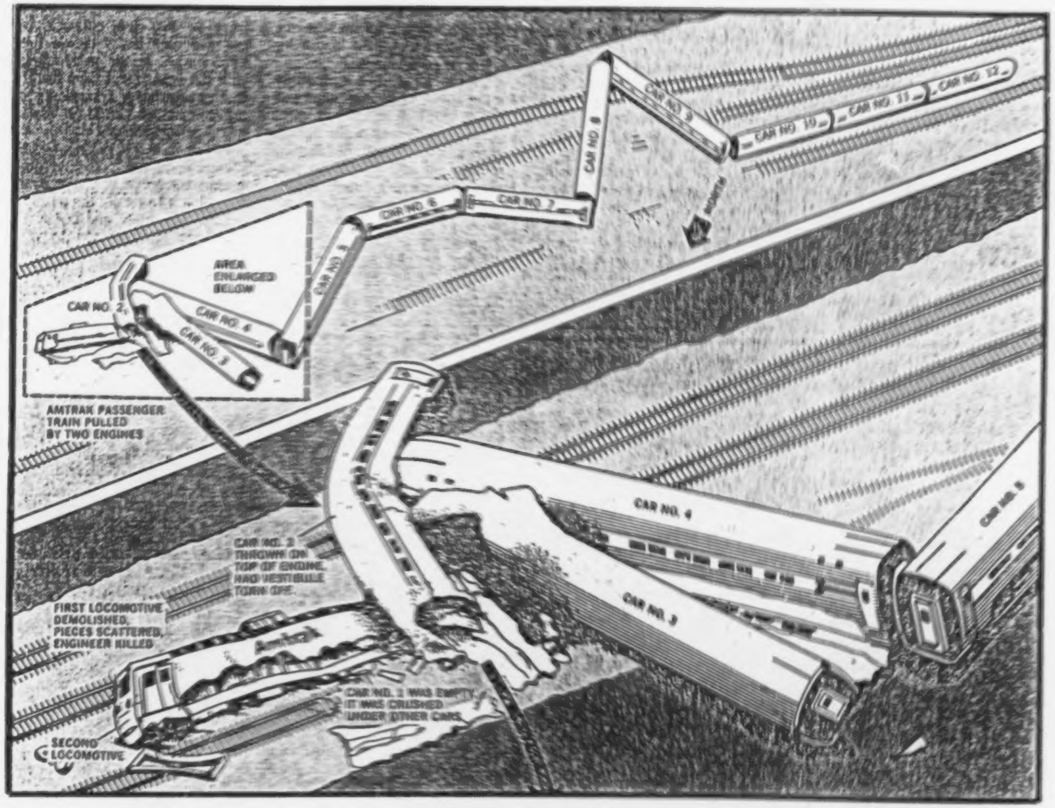
- o Therefore, design and construction standards must be in accordance with those established by...

  -AAR - (ASSOCIATION OF AMERICAN RAILROADS)

  _FRA - (FEDERAL RAILROAD ADMINISTRATION)


85'
END VERTICAL STRUCTURAL MEMBERS
300,000 lb SHEAR VALUE
800,000 lbs
800,000 lbs
TRUCK ATTACHMENT SHEAR VALUE
250,000 lbs
COUPLER TYPE
TIGHTLOCK
VERTICAL LOAD RESISTANCE
100,000 lbs
SHEAR VALUE
300,000 lbs

AAR Design & Construction Standards


CAR NO. 12
CAR NO. 11
CAR NO. 10
CAR NO. 9
CAR NO. 8
CAR NO. 7
CAR NO. 6
CAR NO. 5
AREA ENLARGED BELOW
CAR NO. 2
CAR NO. 4
CAR NO. 3
AMTRAK PASSENGER TRAIN PULLED BY TWO ENGINES
CAR NO. 5
CAR NO. 4
CAR NO. 3
CAR NO. 2 THROWN ON TOP OF ENGINE. HAD VESTIBULE TORN OFF.
FIRST LOCOMOTIVE DEMOLISHED, PIECES SCATTERED, ENGINEER KILLED
Amtrak
CAR NO. 1 WAS EMPTY. IT WAS CRUSHED UNDER OTHER CARS.
SECOND LOCOMOTIVE

Amtrak/Conrail Accident, Chase, MD, January 1987

The figure showing the condition of the AMTRAK passenger train after the recent accident in Baltimore, is a clear illustration of the safety factors considered by AAR in the development and adoption of design and construction standards.

First, the end compressive (buff) loads of 800,000 lbs. required by the recommended practices, as well as the collision posts and the anticlimbing features, contributed to keep the body of the cars virtually intact.

Second, the couplers, also in accordance with AAR recommended practices and designed for the purpose of keeping the cars together without overturning, performed as intended. This feature, in turn, permitted a great degree of energy to disipate by allowing the cars to "jacknife".

Foreign standards are based on the philosophy that the energy should be absorbed by the carbody. We believe this approach, associated with simple pulling couplers, would have allowed the carbodies, under similar conditions, to override the couplers and penetrate or telescope into each other. The consequences could have been terribly different.

AAR standards for the design and construction of rail passenger cars must, therefore, remain as they are. Operating standards and procedures, on the other hand, should be reviewed and revised in accordance with modern practices.

With regard to maglev technology, there are no rules or guidelines currently in existance. Experience gained in Japan and Germany should be carefully reviewed and properly structured and formulated for application in the United States.

DO WE NEED PUBLIC SUPPORT?

- o YES. BUT NOT TO DEVELOP NEW HIGH SPEED RAIL TECHNOLOGY. THIS IS UNNECESSARY
- o ASSISTANCE WOULD BE HELPFUL IN THE RESEARCH AND TESTING OF:
  - APPLICATION OF FOREIGN TECHNOLOGY IN THE U.S.
  - SIGNALLING AND CONTROL SYSTEMS
  - BOGIES AND SUSPENSIONS SYSTEMS ADAPTED TO U.S. RAILROADS.
  - GRADE CROSSING WARNING AND PROTECTION SYSTEMS

FLORIDA HIGH SPEED RAIL
CORPORATION

The United States is more than ready for high speed rail. Determining realistic market demands, utilizing existing facilities to the optimun extent and applying proven technology will minimize the risks, lend credibility to the effort and ensure finaceability.

Technical and economic reliability will be essential to gain riders and general public and private support. This can only be achieved if an evolutionary approach is adopted.

The Florida High Speed Rail Corporation is ready and confident with innovative financing plans; with common sense expertise; with advanced, yet proven technical solutions; with a private effort which has no dependance on public subsidies.

We pledge our commitment and look forward to working with this Committee in any way which will help to bring high speed rail to reality.

FLORIDA HIGH SPEED RAIL CORPORATION
Deerfield Beach, Florida

Mr. LEWIS. Thank you, Mr. Bravo.

Dr. Burdick.

Mr. BURDICK. Thank you, sir.

Chairman McCurdy, Honorable Tom Lewis and other committee members, I am indeed honored that you invited me to testify before you today on a subject that I feel is so important to this great nation of ours.

As I expressed to Dr. Greene, I question that I can add anything new to your proceedings, but I am most grateful for the opportunity to try to be of service.

Before I go into the speech and the risk of forgetting something, I feel that I must respond and disagree with Mr. Bravo with the position that we do not need to develop new technology.

First of all, that is what has made this country great, is the development of new technology and we need to push the development of new technology on all fronts at every opportunity. And I think the comments and the notification of Mr. Lewis earlier today in announcing the great work at the University of Houston that has come out with a new material for superconducting, and that superconductivity has the potential of revolutionalizing and changing everything we say here today in a very dramatic way.

I should think that the government would do everything in their power to insure that the development of that new discovery proceeds with all due haste and is incorporated into our transportation problem at the earliest possible moment.

The other aspect that I would like to comment on is from my view of the existing standards in railroad, although perhaps adequate for existing technology and speeds, clearly will have to be modified and added to as you go to higher speeds.

For one thing, the standards now allow for at-grade crossing and I would agree with earlier testimony that that is absolutely essential that that not be allowed in the future.

Now let me return to my prepared comments.

My background with regard to high speed rail started when I was Dean of Engineering at the University of South Florida. I became concerned over the increasing transportation problems for Florida's metropolitan regions, problems that I deemed were rapidly approaching a crisis. This led to my proposing an Urban Mass Transit Research Center for the state.

The center was approved by the legislature but unfortunately vetoed by then Governor Graham, who I consider a good friend. Perhaps more to the point, my concern also led me to assist Park Wright who was then chairman of the—or later became Chairman of the Florida High Speed Rail Task Force, and many others in the development of the interest for high speed rail in the State of Florida.

I also hosted, in the college, the $2 million Japanese High Speed Rail Feasibility Study in which they did much groundwork for engineering and studying for the feasibility. At that time they were thinking in terms of the Shinkansen and later changed that, which I also agree with, with pushing magnetic levitation technology.

In addition, I have served as Vice Chairman of the Pinellas County High Speed Rail Task Force, and as a member of the Hillsborough County Transportation Funding Task Force.

If I have anything at all to offer this committee, it is most probably observations I have made during the involvement mentioned above. Therefore, I am going to mention a few things that I find are seldom touched on in many of the presentations I have listened to.

First of all, I have a continuing and growing concern for the deteriorating rail capability of this great nation, not only for intercity travel for major urban areas, but as a national resource during, heaven forbid, a time of war. The condition of our rails across the country continue to deteriorate.

In fact, this brings me to one of my major concerns. Some proposals for Florida's high speed rail suggest using existing track and limiting speeds to 120 miles per hour. I seriously question whether the condition of most of the existing track in the United States will support speeds of 120 miles per hour.

In addition, 120 miles per hour could hardly be viewed as modern technology nor a solution to our growing problems. As we can see, these speeds have long been possible in the United States.

However, the realization of these speeds have long been seriously hampered due to poor rail and at-crossings, which also then brings about municipalities wanting to control noise and accidents at rail/highway crossings and then impose speed restrictions that nullify any benefits high speed rail could hope to offer.

It is therefore essential from an operational and safety point of view that there be absolutely no at-grade crossing for any high speed rail system adopted. It has been a particularly costly and painful process for the government to try to eliminate crossings along the northeast corridor, an effort undertaken so that passenger trains would be able to achieve only 120 miles to 125 miles per hour.

In short, the Federal Railroad Safety Act has performed a good service in reducing the number of crossing accidents, injuries, and deaths, but it has not successfully addressed the rapid decline of the United States with respect to state of the art in rail transportation.

For Florida's high speed rail, I would urge us to go with the technology of the future, namely magnetic levitation. It promises to be more reliable, lighter, faster, quieter and less polluting. It has been a long time since I have seen a breakthrough in technology that addressed so many positives and one of those came from the space industry, if you will recall, and our interest to go to the moon, in micro-electronics. And I think we would all be hard pressed to imagine this world today without micro-electronics and the miniaturized integrated circuits that has made computers and so many things possible, that came out of that technology development.

In addition, with the breakthrough in the superconducting materials that we have talked about that will be turned to a superconductor at tens of degrees Fahrenheit below zero instead of the more than 500 degrees below zero needed for current superconductors, promises to do dramatic things to magnetic levitation technology.

A particularly important property of magnetic levitation technology is its ability to accelerate and decelerate trains as rapidly as human comfort will allow. This is something that is seldom, in fact, I do not believe I have ever heard it dwelled on or talked about in any presentation.

At first blush, it may seem to be unimportant, but I think one table can show under certain circumstances it can be of paramount consideration and with your permission, I would like to—I hope this will show okay overhead.

I will just speak from the table and then I will submit the table, of course, for the record, which has already been given to Dr. Greene. Basically, let us consider five possibilities. I am going to consider a train that will do 120 miles an hour, which has roughly been accomplishable for years and years throughout the world, including this country. Then 170 miles per hour, which is roughly what the new Shinkansen will run in Japan.

The data that I give is not to be implied to be what the Shinkansen will in fact do, but I just have taken a hypothetical case that is sufficiently representative of existing technology, to have some relevance. Then 185 mile an hour, which the new TGV will accomplish. Then 250 miles an hour train, which is what the TransRapid vehicle of Germany will accomplish with magnetic levitation technology. Then 320 miles an hour train, which is the top speed roughly that the Japanese MagLev train has been able to achieve.

If we take an acceleration—well, first of all, the 120 mile an hour train I have ruled out, because one of the criteria I am using is a two-hour total time from, say, Tampa to Miami. I used a distance of 260 miles rather than two cities to keep it non-generic in form, but that would be not unlike a distance from Tampa to Miami, let us say.

And a total time for getting on the train at the beginning and off of the train 260 miles later would have to be two hours or less. I personally think you need to be shooting for a goal of an hour and a half to really be competitive with air travel in the future and the way we are going. Today, two hours would do it nicely, ten years from now, I doubt seriously that it will.

But if we take two hours as the upper acceptable time to travel that distance, then you have to rule out the 120 mile an hour train before you even start, so it would not be in the consideration.

The next thing of a consideration is that you may want to service people between the initial point and the final point. If you want to service those people, you are going to have to make a number of stops, so the variable that I am considering now is how many stops can you make between the beginning and the end and still get there in two hours with these various kinds of trains.

The one variable that becomes important in that consideration—there are two—one principle variable is the acceleration/deceleration, how long does it take you to get up to speed and how quickly can you stop.

The next consideration is how long does it take at each stop and that is simply human behavior and time and motion studies and design so that you can get people on and off quickly. So I have used three scenarios, a ten-minute stop, a five-minute stop and a two-minute stop.

I think it is not inconceivable that you could shoot for a one-minute stop, one minute is longer than a lot of people realize, if you address yourself to that issue.

For the 170 mile an hour train, I have used three miles per hour per second for acceleration and deceleration simply because that is the maximum you could ever achieve with a wheel and rail combination. Steel on steel starts slipping, so its adhesion limits you to an acceleration rate even if you motorized every car, you could never achieve more than about three miles per hour per second with steel on steel. And you could stop in a corresponding period of time.

Using that and you had a ten minute stop, you would be able to make two and a half stops between the beginning and the end if you took ten minutes at each stop. You would be able to make 4.6 stops if you took five minutes at each stop and that goes to nine stops if you use two minutes at each stop.

If you use a faster train now, but used an acceleration rate that is typical of, let us say, the TGV until the new model came out, it was limited to a three and a half percent grade capability.

Its acceleration is less for two reasons. One is the technology, the major reason being that they use locomotive power instead of distributed power. By that I mean there was only one power car for every five cars in the train. That reduces your acceleration capability by a factor of five, that alone.

So then if I use a realistic acceleration factor then of .77 but the same deceleration factor in applying the brakes, steel on steel, that gives a lost time of 2.5 minutes every time you start and stop, total lost. Whereas the earlier train only had a one-minute lost time for that same operation. With that combination, if you made ten minute stops, you would be able to make 2.7 stops. Compare that with the 2.5 we had for the slower train, so even though it is 15 miles an hour slower, with increased acceleration you could have a comparable number of stops.

If you have five-minute stops that becomes 4.6 to 4.5, essentially exactly the same. But now if you reduced it to two-minute stops, the 185 mile an hour train can only make 7.4 stops, whereas the 170 mile an hour train with better acceleration factors could make 9.3 stops. You can make two additional stops and still have no greater time from the beginning to the end.

This to me is extremely important. That means I can develop two new areas internal to the state at no extra cost with a slower train. This becomes even more dramatic if we move on to magnetic levitation technology.

At the 250 mile an hour, if we use a two-mile per hour per second acceleration and deceleration—let me mention one other thing at this point. Magnetic levitation is not limited with the coefficient of friction between steel and steel. Its linear motors and the interaction with the magnetic field allows it to start and stop as quick as human comfort will permit, so your only limitation is an engineering design limitation and an evaluation of how much acceleration the public can tolerate comfortably.

The Germans so far have been using two miles per hour per second. If we use that as a figure for a 250 mile per hour train, you lose 1.7 minutes every time you start and stop. Then if you make a ten-minute stop, you would be able to make 4.8 stops between the beginning and end of this trip. For five minute stops, you could make 8.4 and for a two-minute stop you could make 15 stops and still achieve your two-hour deadline. We have nearly doubled the stops by going to magnetic levitation at 250.

The technology has already achieved 320 and in time it will become economic to operate at those speeds. And if we use 320 miles an hour with a seven mile per hour per second acceleration/deceleration, and that is what is actually being achieved by the MagLev in Japan at this point in time. They actually accelerate and decelerate, and that is not unlike what you would experience on some commercial airliners when you take off.

You will sometimes experience a seven mile per hour per second increase in your speed. Then you only lose eight-tenths of a minute every time you start and stop. For ten minute stops, you could make 6.5 of them, for five minute stops you could make 12 and for a two-minute stop you could then make 25 stops from the beginning to the end and still achieve your two hours. It also affords the potential of reducing that to an hour and a half over that 260 miles, were that your choice.

So the importance of these parameters can do a lot to assuage or modify one's analysis of the importance of speed in the technology. And I think it is also important if we go with steel on steel, we are limited in our acceleration and deceleration forevermore with the friction between steel and steel.

And the most you could ever stop, the fastest you will ever be able to stop or start will be roughly just slightly over three miles per hour per second, even with sanding operations and other things you could do that would enhance that a little bit and modify it upwards a little, but very little.

Mr. McCurdy. Dr. Burdick, could I ask you one point here?

Mr. Burdick. Yes, sir.

Mr. McCurdy. Could you address the life cycle cost? I am also on the Armed Services committee and we tend to look at issues like that, of new technologies such as MagLev versus steel on steel. Is there a maintenance cost where there is high risk there in MagLev or is it less than steel on steel? What are the things that we worry about breaking down and what is the operation and maintenance cost?

Mr. Burdick. I will address that a little bit later on, but basically, the maintenance aspects are far more optimistic for magnetic levitation than for any technology, because you eliminate moving parts. The greatest thing on maintenance mainly is rotating wheels and bearings and things that just wear out after they have rotated so many times.

Flattening of wheels on wheels on steel, you lock the wheels once, it is flat and you have to replace that wheel. With the magnetic levitation you are floating, so to speak, you are levitated and there are no moving parts. It is a linear motor, you are being pulled along by electronic switching of a magnetic that stays ahead of you all the time kind of like the carrot in front of the horse. It just stays there and the train keeps chasing it, or MagnePlane, if you prefer, which is an interesting new terminology and gets away from our biases of train, as such.

But in all of the features it is not there yet. In fact, let me correct that. There are several technologies in magnetic levitation now that I think need to be clearly understood. There are two different high speed magnetic levitation approaches being used. It has already been mentioned in the testimony here today.

That is, the Japanese use a repulsion system and they do it by superconduction techniques and a power plant aboard the train itself, and that is perhaps one of their largest engineering problems to overcome, but it gives them a lot greater efficiency once they go to a superconductor, you do not have to waste any electrical energy, the energy then is wasted in keeping the superconductors cool.

The Germans on the other hand use conventional electromagnetic magnets. That gives them the advantage that they do not have to go to superconduction. It also lets them levitate the train at rest whereas the Japanese have to get to a speed in excess of 70 to 100 miles an hour in order to levitate. So they actually start off on rubber wheels and pick those rubber wheels up as they move along.

In addition, though, we always have a tendency to think of magnetic levitation as implying high speed and that is not true at all. There is a very successful commuter system working with magnetic levitation in Birmingham, England from the Expo over to the airport, much the way as the Tampa International commuter train, Westinghouse cars, that run back and forth from the terminal to the satellite.

Birmingham did an analysis when they put in their system and found out that it was one-third the construction cost that the Westinghouse system would have cost them in England, and they evaluated the Westinghouse system which is being used in Tampa now.

So their construction costs, according to their analysis, ended up being 50 percent cheaper than the nearest competitor using magnetic levitation. So the technology for the commuter line now, and that is also what Las Vegas is putting in, is a magnetic levitation system, seems to be competitive and less expensive than any other technology now.

It will certainly, I think, prove to be more reliable. The maintenance cost will be far less, the people required to run the train will be less because you can do it all by computers and the visibility of people will probably be there just to keep customers happy because they like to see a person once in a while instead of a computer.

The Shinkansen and the TGV can be largely computerized as well. So that is basically my comments with regard to that aspect.

Let me run through a few slides here that may be the most productive at this point. We will skip that slide right now, it will be in the material given for the record.

Here I just wanted to show the fact that we have had the metroliner around for a long time and its speed in miles per hour will go up to 160 miles per hour. Operational efficiency, the condition of the track, at-grade crossing; all of those things have prevented it from becoming a widely used system, but you can see that was acquired back in 1968. So 160 miles an hour is something that we have had for some time.

Here you can see that the Department of Transportation of the United States achieved 257 miles an hour in its pioneer truck years and years ago and it is something that simply was not developed and did not become operational, but as far as the ability and the technology to achieve, this country has been very successful.

That is the Shinkansen and that is the one that has the power system on every car and therefore it can achieve the three mile per hour per second in principle, if you have the motor go up high enough. They are not actually achieving that right now but they are coming closer to it than the TGV because of its locomotion system.

That is the TransRapid System in Germany and it uses the attraction system and it, too, has just one centimeter of clearance now between the train and the rail itself, whereas the repulsion system achieves typically more like four inches and capable of achieving several inches. There are those that will argue that the one centimeter will prove problematical. The Germans have had a little trouble with it but they seem to be operating so far with acceptability so I think the answer to that is yet to be determined.

This is the German's feeling that 180 miles an hour simply will not do it for future transportation and I happen to agree with that. And this shows what their MagLev system is capable of doing. They can do 180 miles an hour in 90 seconds, that is two miles per hour per second or 240 miles per hour in two minutes, which is still the two miles per hour per second that is shown here at the acceleration rate.

That is simply the Japanese magnetic levitation train, another view of it.

And this is the top speed achieved by the Japanese train, 517 kilometers per hour, roughly 320 miles per hour, and it shows—you can see that it gives you .328 g, that is an acceleration factor that is roughly seven miles per hour per second, rounding it off, and you can speed up in theory, in principle, as rapidly as you can slow down and you are not limited to the friction between steel and steel.

That basically finishes the slides that we have.

In closing, I would simply like to say that I think we have already made demonstration track that I have been promoting ever since I have been involved with high speed rail and that is the transportation center of tomorrow at Disney World that would have a MagLev to take you over to the space center in seven minutes.

You have got all the ridership you could want, you have got the glamour and attraction of the world's best attraction. It should demonstrate and work out any bugs very quickly on a fairly short run, so that it would be safer and better for the general public of Florida, and the United States, when it was actually installed, and I still think that would be a great demonstration.

I will be happy to answer any questions you may have.

Mr. LEWIS. Thank you, Dr. Burdick. I think because of the time constraints, one member had to go to catch a plane and Mr. McCurdy is going to have to leave in a few minutes to catch a plane, that we will ask you to reply in writing.

Now, Mr. Bravo, I understand that once you have decided on your reward for technology, you are going to advise us of why your company decided to do that.

Mr. BRAVO. Absolutely.

Mr. **Lewis**. We appreciate this panel very much. Your technical background certainly is outstanding in this field, Dr. Burdick and we are pleased to have you with us.

Mr. **Burdick**. It has been my honor.

Mr. **McCurdy**. I concur totally. I think it has been most helpful, as has all the witnesses testimony and statements and we appreciate your participation.

Mr. **Lewis**. We do have with us Jim Minix, St. Lucie County Commissioner and also former County Commissioner Bill Palmer with him. We recognize them if they would like to take a few moments and make a few comments. I know you are vitally interested in high speed rail.

STATEMENTS OF JIM MINIX, ST. LUCIE COUNTY COMMISSIONER AND BILL PALMER, FORMER COUNTY COMMISSIONER

Mr. **Minix**. Mr. Chairman and members of the committee, thank you very much for allowing me just a few moments to speak and I will make it very short. I understand the time limitations.

St. Lucie County is very much interested in participating in the high speed rail project. Not only is the County Commission committed but our private sector as well.

I think we can best contribute to this hearing by emphasizing this fact. Our Commissioners have hired a consulting team to assist us.

Mr. Bill Palmer, a member of that team is with me today. This is Mr. Palmer right here. Our consultants have compiled a list of private land owners that wish to participate in this project. All together, we had more than 70 land owners that responded. The minimum amount of land was 100 acres and the maximum was more than 2,000 acres. These land owners are willing to participate with donations of land or by becoming a part of the joint venture.

Presently our county is listed as the fourth fastest growing metropolitan area in the country. We believe the high speed rail project is the answer for our transportation problems of the future.

I want to thank you for this opportunity to speak about this very important project and I would just ask Bill very quickly to point out on the map that Bill carries with him in his car, the areas along I-95 and the turnpike, which both come into our county, just where some of this land is located.

Mr. **Palmer**. Yes, gentlemen. The major lands that were suggested was a 5,600 acre tract up here which they are willing to set aside 100 to 200 acres here that they would like to give. Then you have a project which is 1,800 acres and St. Lucie west where the new New York Jets are going to be, that is a 4,700 acre tract. Then you have the Duda Sons that has 9,000 acres but we are going to develop 1,000 first.

Those are the major ones that we would like to mention. Also in concert with that, we have a 20-year FAA approved plan and with the help of Congressman Lewis, we have a 100 foot tower there now which will go in operation sometime this year.

So if you look in this area with a three mile radius, we are a transportation hub with Sunshine Parkway, I-95, an international airport, international deep seaport, U.S. 1 and FEC Railroad, and we would certainly love to have the high speed rail come to us also.

Thank you, gentlemen.

Mr. MINIX. I think the really important part of what we are saying today is that the private sector is very anxious in our country and I am sure they would be in other counties. And thank you again for this opportunity.

Mr. LEWIS. Thank you again, Commissioner, as well as you, Mr. Palmer.

Mr. Chairman, I want to thank you very much for coming down and agreeing to hold this hearing here in the heart of high speed rail country. We appreciate you doing this in the land of sunshine, and it is just a pleasure working with you and thank you for all your efforts and interest in this area.

Mr. MCCURDY. Well, thank you, Tom. I would like to commend you for your leadership in this area, and it certainly takes people who are interested in having this be developed in your area. We all understand that it takes that kind of initiative I think to get the Federal Government involved. And as I said earlier, our interest is from technology, where it is moving, the United States needs to move forward.

As I mentioned in my comment earlier, I am a member of the Armed Services committee and we had a proposal yesterday to spend anywhere from $2 to $5 million to do research and development on rail mobile MX, and quite frankly, I can see spending more money on passenger technology than I can on rail mobile MX. Even though we do not have a very good rail system in Oklahoma, it certainly does not deter me from being involved in some of the new technologies.

Again, I would like to thank all the witnesses who appeared for us today and the staff. You did a good job on the accommodations.

With that, we stand adjourned.

[Whereupon, at 12:18 p.m. the subcommittee was adjourned.]

APPENDIX

Field Hearing
High Speed Railroad Technology
April 3, 1987; 9:00 AM
Commission Chambers
City of West Palm Beach
Palm Beach County Courthouse
200 2nd Street
West Palm Beach, Florida

OBJECTIVES:

1. To examine the various high speed railroad technologies.
2. To explore the status of development of new high speed railroad technologies.
3. To assess the usefulness of high speed railroad technologies in Florida.

SUMMARY:

The State of Florida plans to construct and operate a high speed railroad by 1995. Several corridors for the railroad are under consideration including the heavily populated West Palm Beach to Dade County route. The technologies being considered include:

1. high speed equipment on existing track such as the 125 mph LRC of Canada and the HST of England,
2. state-of-the-art technology on new track such as the 162 mph TGV-PSE of France and bullet train of Japan, and
3. new technology, the 250 mph Mag-Lev electromagnetic and the 310 mph Mag-Lev electrodynamic.

BACKGROUND:

1. Rail Speed up to 130 MPH

A. One example is the Amtrak electric passenger train, which travels up to 120 mph in the Northeast U.S.

B. The LRC (Light, Rapid, and Comfortable) high speed train is powered by a diesel-electric locomotive up to 125 mph on existing track. It has been utilized for a decade in both the U.S. and Canada. The use of aluminum carbodies and other features contribute to its speed.

C. The HST (High Speed Train) is a lightweight diesel-electric locomotive train. They were first operated in 1976 in England. It is considered a conventional train operating on existing track utilizing available technology to obtain speeds up to 125 mph.

2. Rail Speed of 140-160 MPH

The trains in this category are all-electric and can operate on improved existing track. These trains are manufactured in Germany, Italy and England. Development of England's version, the Advanced Passenger Train (APT) has been very slow due to various technical problems.

A. The French TGV (Tres Grande Vitesse) is an electric train, receiving power from an overhead wire. Two separate locomotives which provide propulsion, advanced aerodynamic design, lightweight materials, etc. account for the high speeds.

B. The Japanese Bullet Train (often called the Shinkansen) is an all electric, lightweight train. In fact, the carbody structure has a compressive strength of 220,000 pounds, which is considerably lower than the 800,000 pound federal structural requirement. The train has been in operation in Japan since 1982.

3. Rail Speed up to 230-300 MPH

All trains in this category use magnetically levitated (Maglev) technology. The train is powered by electromagnetic forces, which also suspends the train above the rail. Thus the levitated train glides on a cushion of magnetism at speeds up to 300 mph. Because the technology has not been fully developed, there are no trains in commercial use. Those under development include:

A. German Maglev, utilizing magnetic attraction forces, and

B. Japanese National Railroad (JNR), utilizing superconductive magnetic repelling forces.

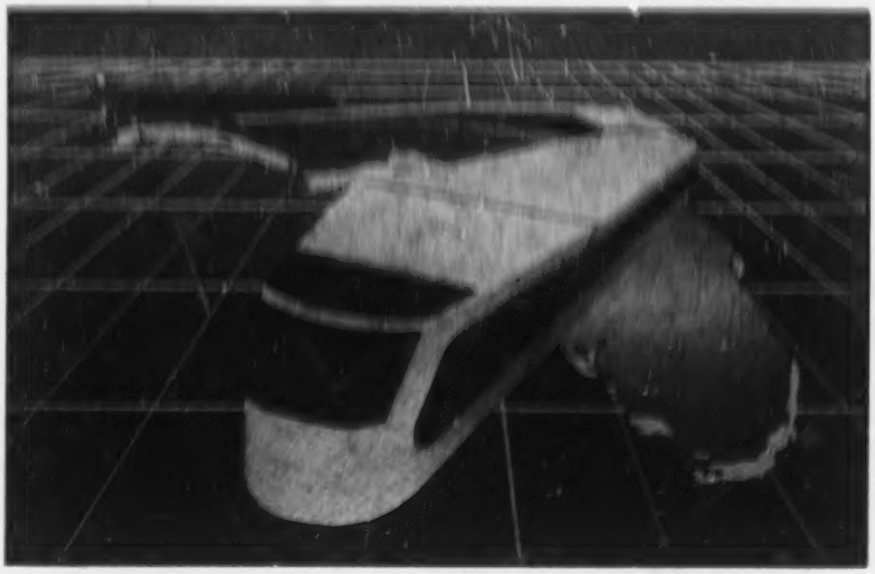
HEARING:

The hearing will focus on the status of development of a high speed railroad system in Florida and the various railroad technologies suitable for use in Florida.

Witnesses invited to testify include the Administrator of the Federal Railroad Administration, the Secretary of the Florida Department of Transportation, the Chairman of the Florida High Speed Rail Transportation Commission, scientists and engineers involved with developing the various railroad technologies.

Issues to be addressed by the hearing are: the track requirements, noise levels, emission of pollutants, safety, initial cost and long range maintenance.

FLORIDA'S HIGH SPEED RAIL STUDY



FLORIDA TODAY

Florida has labored over transportation problems since long before Henry Flagler's first train chugged into Miami and his Florida East Coast Railroad triggered phenomenal growth in the state. Today, the 4-lane Howard Frankland Bridge across Tampa Bay is jammed with traffic between Tampa and St. Petersburg. In South Florida, bumper-to-bumper traffic creeps along six lanes of I-95 during the inappropriately named "rush hour."

Between 1960 and 1980, the resident population of Florida doubled from almost 5 million to 10 million, and the state continues to attract increasing numbers of tourists. Only 13 years ago, Walt Disney World opened in Central Florida. Other major attractions such as Sea World and Busch Gardens, along with beaches and natural recreation areas, have also played a big part in Florida's tourism development. In 1983, over 40 million tourists visited the state. This compares to fewer than 20 million in 1967.

Florida has changed dramatically over the past 20 years, not only in population growth, but in the distribution of that population. In 1960, approximately 65 percent of the population lived in Florida's urban areas. By 1980, almost 85 percent of the state's inhabitants lived in urban areas—making Florida one of the nation's most populous and urbanized states.

Florida's ability to grow and develop has been determined in large part by its transportation systems, such as the interstate highway system implemented in the past 25 to 30 years. Such major transportation systems, of course, take considerable time to plan, design, finance, and construct.

Florida in the 21st Century will be shaped by planning done today for the transportation systems of the future.

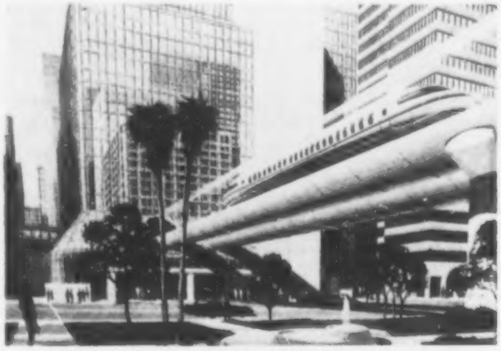
...AND IN THE FUTURE

In 25 years, the Howard Frankland Bridge will need 14 lanes across Tampa Bay if the number of cars and trucks increases as predicted. By the year 2020, 44 lanes will be needed between Ft. Lauderdale and Miami on I-95 if alternative methods of travel are not ready.

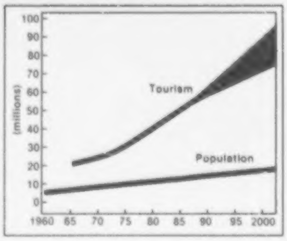
Experts say Florida's growth will continue at a rapid rate for the next generation. By the year 2000, approximately 17 million people are expected to live in Florida, making it the third or fourth most populous state in the country—about as large as New York State today. By the year 2020, almost 21 million people are expected to live in the state, doubling today's population. Thus, today's transportation planning will be important in guiding Florida's future development and population growth.

It also is anticipated that Florida will continue to grow in attractiveness as a tourist destination. Forecasts indicate significant tourist travel increases, to between 70 and 90 million annual visitors by the year 2000. Additionally, the state has positioned itself to continue to attract commercial and industrial expansion to provide future employment opportunities.

The urbanization trend is expected to continue with transportation playing a key part in growth, development, and redevelopment of Florida's cities. Highway construction will continue to be necessary, as automobiles remain a primary mode of transportation. However, cost-effective and efficient mass transit solutions also must be developed in urban areas and as connecting systems between major metropolitan areas. The expense of a solution relying solely on new highways and new airports has already become prohibitive in the most urbanized areas of Florida. Rapid transit systems, bus lanes, downtown people movers, and similar transit projects provide effective alternatives to balance future transportation needs.



C



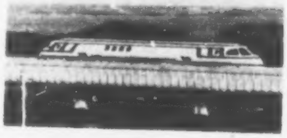
WHAT IS HIGH SPEED RAIL?

Imagine skimming along between Miami and Orlando on a cushion of air at speeds up to 400 miles per hour as you sit reading the daily newspaper. It's a dramatic change from the trains on Florida's tracks today. High speed rail service is available today on passenger trains operating in Japan, France, Great Britain, Canada, and West Germany. Florida is poised to catch up and excel in technology, speed, and economic growth.

State authorities are considering a variety of different high speed rail technologies, including some advanced systems that are in prototype development. The three technologies under consideration operate at the following speed ranges:

- Type I—High Speed Equipment on Upgraded Track (100 to 130 mph).
- Type II—State-of-the-Art Technology on Totally New Track (130 to 170 mph), and
- Type III—Very High Speed New Technologies (230 to 320 mph).

The state of the art in high speed passenger equipment now operating is represented by the TGV-PSE (France), Series 200 Bullet Train (Japan), Intercity 125 (Great Britain), and LRC (Canada).



D

In a few years, the present state of the art in high speed passenger transportation may drastically change, from steel wheels/steel rails to trains that literally fly over their guideways. These are known as magnetic levitation (Maglev) systems with vehicles held aloft by magnetic forces and propelled forward by a special new-technology linear motor drive.

Two different uses for a high speed rail guideway have been suggested for Florida. The first is "express service" that would be available on an hourly basis, linking high-demand urban areas and major travel markets in central and south Florida. The second concept is to have more frequent "commuter service" within the urban areas that would serve both local and state travel needs. Hourly express service between major cities still would be available, but more localized/regional transportation needs, including commuter service in urban areas, could also be provided on the same system.

HISTORY OF HIGH SPEED RAIL IN FLORIDA

In the mid-1970s, the State of Florida examined the possibility of a high speed rail corridor linking Tampa/St. Petersburg, Orlando, and Daytona Beach through the central part of the state. In the early 1980s, the Japanese indicated an interest in developing a system that linked Tampa/St. Petersburg, Orlando, and Dade, Broward, and Palm Beach Counties in South Florida.

In April 1982, Executive Order 82-34 was issued by Governor Bob Graham creating the Florida High Speed Rail Committee. The Committee set forth the following objectives:

- Determine the public benefit likely to accrue from high speed rail service;
- Determine the market and engineering feasibility of such a system, including route location and priorities;
- Establish design and construction specifications and criteria;
- Determine the feasibility of utilizing existing publicly owned rights-of-way for high speed rail service and, if found feasible, prepare a request for proposals for leasing of same; and
- Prepare requests for proposals for franchising, design, construction, operation, and maintenance of the system to a private entity or entities.

Over a 2-year period, the High Speed Rail Committee conducted nine public hearings around the state and heard testimony from citizens, public officials, potential franchise applicants, representatives of environmental groups, and officials from federal, state, and local agencies. Information on various types of high speed rail technology was presented, and the Governor and several committee members visited and rode high speed rail systems in Japan and Europe, including the prototype Maglev train in Japan.

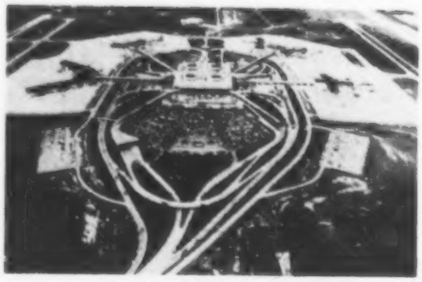
In October 1983, an advertisement was placed in the *Wall Street Journal* requesting prospective franchise bidders to submit conceptual proposals for the financing, design, ownership, and operation of a high speed rail system in Florida. Seven proposals were received, indicating substantial business community interest in the private development of the project.

4

FUTURE TRANSPORTATION SYSTEM

The High Speed Rail Committee concluded its work in April 1984 with a final report to the Governor. The Committee's findings and recommendations were that:

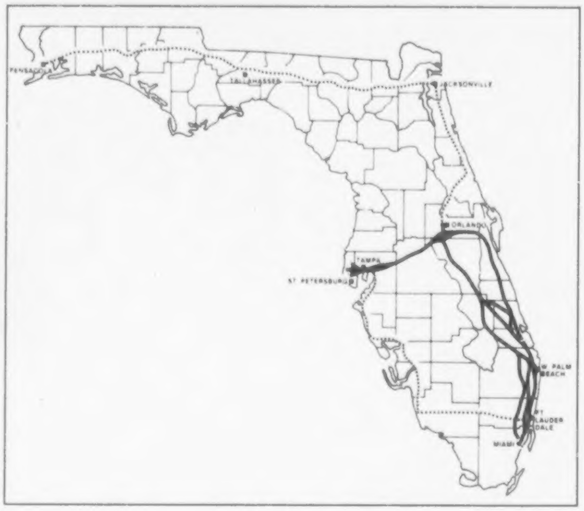
- Florida's present transportation infrastructure is inadequate to accommodate the growth forecast to occur over the next 16 years.
- Expansion of traditional modes to overcome present and future transportation inadequacies is not economically or environmentally feasible.
- An advanced high occupancy interregional mode of ground transportation is essential to Florida's mobility in the 21st Century.
- There appears to be great public benefit from the development of a high speed rail system through safety, high speed convenience, economy, and the creation of jobs for construction and on-going operations.
- The technology is currently available to provide Florida with a "world class high speed rail system" that is most suitable for serving Florida's interregional travel market in the 21st Century.
- The implementation of a high speed rail passenger service can be accomplished by means of a multi-year franchise financed and developed entirely by private free enterprise.
- The development and utilization of high speed rail systems technology could act as a catalyst for economic growth, and could be a key factor in shaping Florida's future growth in a well-planned and managed direction.


C

D

Both the use of existing highway and rail corridors as well as new corridors have been proposed by prospective franchisees. The ability to serve the state's transportation needs using existing corridors versus the development of new corridors will be a critical part of the decision in the award of the franchise.

POTENTIAL SERVICE CORRIDORS



What areas of the state will be served by high speed rail service — where will it go?

Alternative corridors have been identified for potential high speed rail service in Florida. Corridor selection was based on engineering, socioeconomic, and environmental factors. Routes that had the least potential for engineering problems or for the disruption of existing land use and environmental resources were identified. Although all the corridors connected the major metropolitan areas in central and south Florida, various options were identified to link intermediate markets and the state's major airports and tourist attractions. The Tampa/St. Petersburg, Orlando, and Miami-Ft. Lauderdale metropolitan areas were shown to have the highest potential for generating passenger demand in studies conducted for the Florida Department of Transportation.

A minimum of 50 feet of right-of-way is needed for double tracking of any high speed rail system under consideration. To maintain the speed capabilities of high speed trains, it is necessary for the track to be designed with wide gentle curves. In order for high speed rail to utilize existing state highway and rail corridors, it may be necessary for the train to operate at slower speeds where sharp curves exist. Rail systems with slower speed ranges will "fit" more easily into existing corridors. Faster technologies, such as Maglev, may require the development of new, straighter rights-of-way.

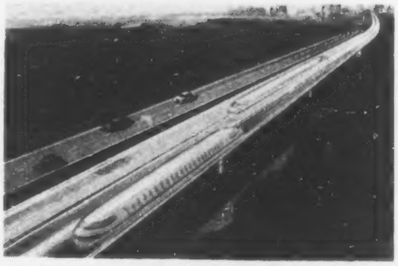
A special corridor approval process, as enacted in Florida's High Speed Rail Transportation Commission Act, is required prior to the award of the franchise. Corridors must be identified and environmental impacts determined by each potential franchisee. Opinions and comments from the public and local governments will be solicited in order to refine the corridor alignment and determine which routes will result in minimal impact to public health, safety, and welfare.

WHAT IT MEANS TO YOU...

The most important aspect of this project is that it is not anticipated that tax money will be used. A variety of financing mechanisms, such as joint real estate development, revenue bonds, innovative equipment leasing arrangements, and corporate loan guarantees, could be used to provide the capital and operating funds needed to implement high speed rail in Florida.

There are a number of benefits for the State of Florida in the development of a high speed rail system. First, a distinct positive image for future growth and development will be projected worldwide. The implementation of high speed rail in Florida will maintain or improve Florida's image as a premier center for tourism and high technology development.

The second positive impact is that a new means of public travel will be available to meet Florida's complex transportation needs. High speed rail will be competitive in travel time with aviation, whose expansion is being hampered by increasing problems of congested airspace. The travel time for high speed rail is expected to range from under 2 hours to 3½ hours for a Tampa/St. Petersburg to Miami run, depending on technology and route configuration.



Another anticipated effect of high speed rail will be improved transportation safety. High speed passenger trains operating abroad have produced outstanding safety records. Since operation of the TGV system in France began in 1981, there have been no injuries or fatalities. The safety experience of the Japanese National Railway system is also quite similar. To the extent that travelers are diverted from automobiles to high speed rail, the latter's superior safety record should result in a decrease in automobile traffic accidents and decreased aviation delays and airspace congestion, allowing for an improvement overall in transportation safety.

The Florida Department of Transportation made an intense examination of the benefits of high speed rail compared to system costs. There will be benefits for both users and non-users. User benefits include reductions in automobile operating costs, travel time, and accident costs. Tangible economic benefits, such as increased employment and wages, will occur as a result of construction and operation of the high speed rail system. These new jobs will mean at least $3.8 billion in employee earnings during the first 30 years of the project. In addition, high speed rail is expected to result in increased expenditures by tourists in Florida. It is expected that the ripple effect of those increased expenditures will result in the creation of approximately 30,000 jobs per year or 1.1 million new jobs over the period from 1990 to 2020.

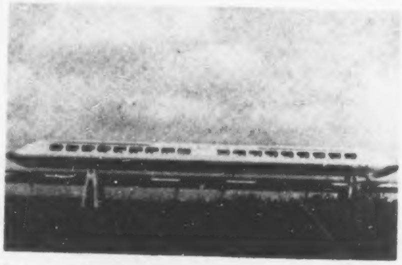
SYSTEM IMPACTS

Construction and operation of a high speed rail system in Florida will have both positive and negative impacts. Many of the negative impacts can be reduced with proper planning and coordination.

The proposed high speed rail facility has the potential to enhance Florida's air quality as auto travel is replaced by electrically powered transportation, and projected increases for aviation facilities and airspace congestion are reduced. Additionally, a reduction in energy consumption would be a major asset of high speed rail development in Florida. The technology of high speed rail makes it the most energy-efficient mode of transportation available compared to buses, automobiles, or airplanes. Most high speed rail systems are twice as efficient as airplane travel.

The high speed rail system will provide considerable development and redevelopment opportunities, especially around station locations. Transportation facilities have been a major influence on development patterns throughout Florida in the past. Planned growth and more efficient land use are a natural result of improved transportation access as are lower overall utility costs.

A major non-cash tax incentive that is planned for the potential franchisee is the exemption from taxes for the system and related development. This will mean that lands associated with the project will be under public ownership and will not be on local tax rolls. However, the High Speed Rail Transportation Commission Act specifically allows the charging of impact fees to offset any local government costs for utilities and other items needed to support the system.

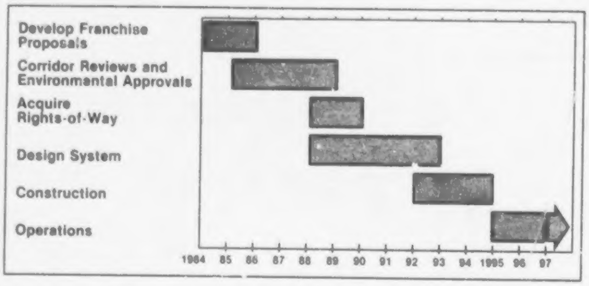


C

Unless properly planned and designed, the development of high speed rail in Florida could also have adverse effects on the environment and on the communities through which it travels. During construction, air and water quality could be temporarily affected. In addition, local communities may be disrupted due to construction and the possibility that some businesses and residences will need to be relocated. Noise will be evident during construction and could become a concern when the system is operational unless sound barriers are provided on right-of-way that is adjacent to residential neighborhoods. Vibration effects may also be experienced, although structural design techniques will be used to reduce or eliminate this problem.

SCHEDULE FOR DEVELOPMENT

During the 1984 session of the Florida Legislature, a law was passed creating a Florida High Speed Rail Transportation Commission. The act empowers the Governor to appoint a commission to award a franchise for the development, construction, maintenance, and operation of a high speed rail system. The High Speed Rail Transportation Commission Act was approved by the Legislature May 30, 1984, and signed into law by Governor Bob Graham June 14, 1984. This act is a landmark law not duplicated elsewhere in the United States.



Governor Bob Graham has expressed a desire to see the high speed rail project operational by 1995, the 150th birthday of the State of Florida. To develop a high speed rail project in Florida, considerable time is necessary to obtain all approvals at the federal, state, and local levels, to finance the system, complete design and construction, and perform test runs prior to full service operation.

The first links to be developed would be the highest travel demand corridors linking Tampa/St. Petersburg, Orlando, and Miami. Expansion of the system to other major urban areas, such as Jacksonville, Sarasota, Daytona, and Ft. Myers, would be accomplished shortly thereafter.

In its approach to the project, Florida is unlike other states which are pursuing the development of a statewide high speed rail system. Local comment, concern for environmental issues, and private sector operation and financing have been considered essential in Florida to the successful development of this new means of travel in the state. Considerable efforts have been made to consider early in the planning process citizen and agency concerns about service, routes, and technologies offered by the prospective franchisees. To accommodate this complex planning process, the timetable for development may stretch over the next 10-12 years as route selection, design, environmental permitting, and a multi-year construction schedule are completed.

...A COMPLEX DECISIONMAKING PROCESS

It is thought that high speed rail passenger service in Florida will be accomplished by means of a multi-year franchise financed and developed entirely by private enterprise. There are a number of reputable consortia interested in the franchising rights for Florida's high speed rail passenger service. Private enterprise has proposed to design, construct, own, operate, and maintain the Florida High Speed Rail Transportation System.

A high speed rail project in Florida will involve a complex review and approval process at the federal, state, and local levels. Review and approvals for the location of the facility and permits to construct and operate the system will be required. Public and private interests all will be involved in the review of such a large-scale transportation development project in the state.

On the federal level, review of environmental impacts and negotiations for joint use of existing highway rights-of-way will be required. At the state level, similar environmental permits and approvals will be required. Local governments will be interested for the same reasons as federal and state agencies, but will also review the project to determine its impact on land use plans and zoning, and to identify utility improvements (water, sewer, transportation connectors, etc.) that the system will need.

Coordination and comment from the public, environmental agencies, and interest groups must also be accomplished to ensure timely review and approval of the variety of permits required by Florida's unique legislation. Residents will be involved in the decisionmaking process and will be asked to participate during a series of local, regional, and state public hearings to be held along the corridors of the high speed rail system. This process will ensure that the system is developed with full community support and that it is structured in a way that truly meets Florida's transportation needs and the needs of its people.

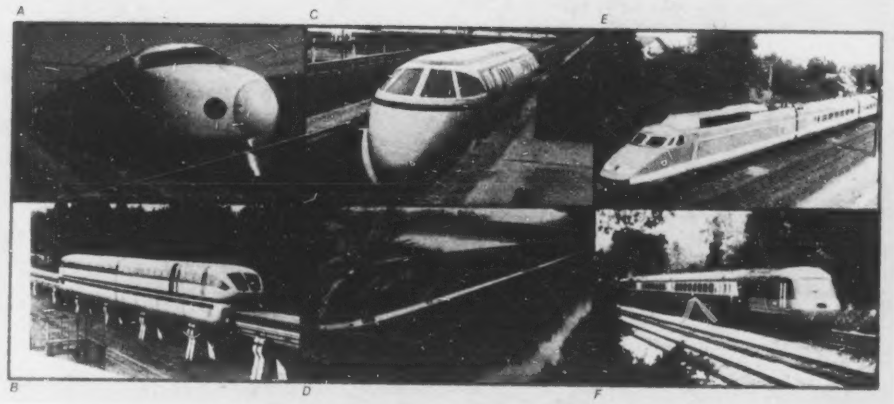


PHOTO IDENTIFICATIONS
(Photo Source Acknowledgements)

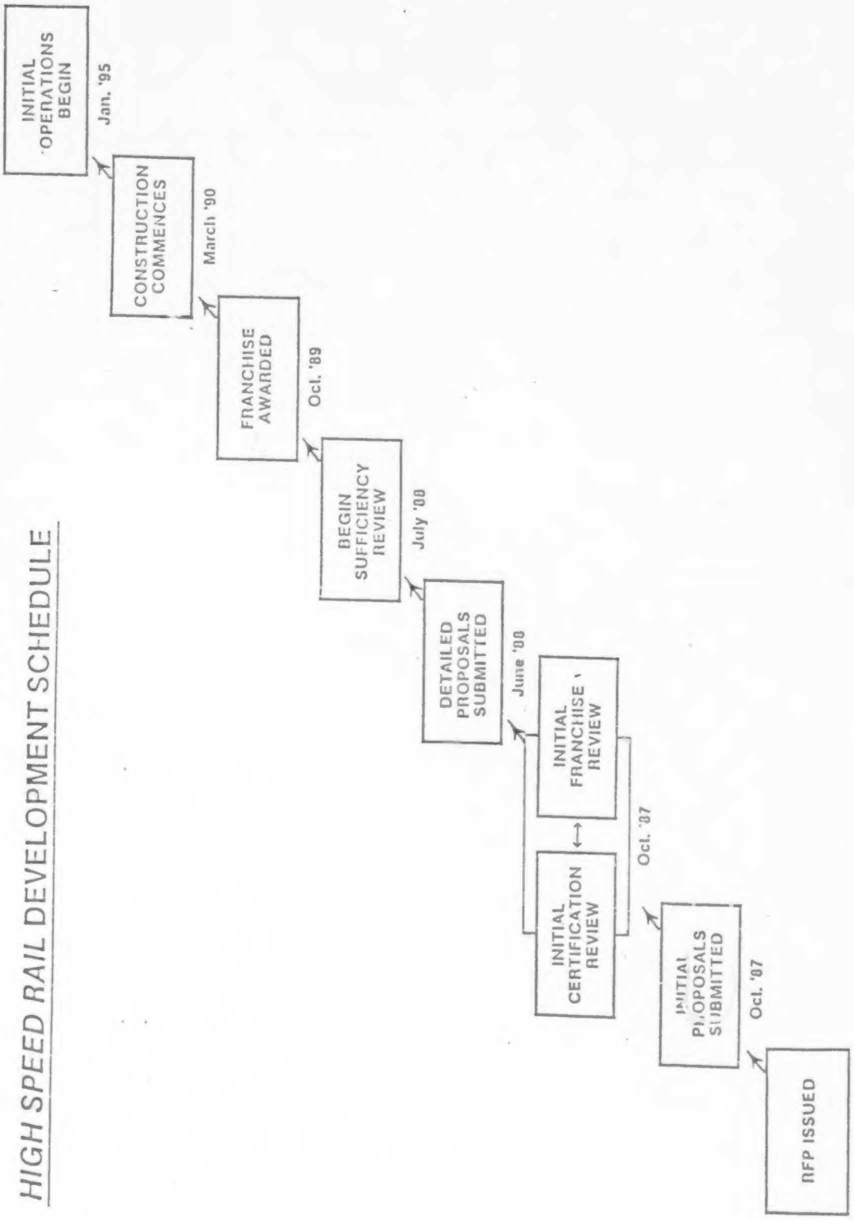
A. Series 200 Bullet Train (Japanese Railway Technology Corp.)
B. Super Speed Maglev Train (The Budd Company)
C. Prototype Maglev Train (Japanese Railway Technology Corp.)
D. Artist's Rendering (Bombardier, Inc.)
E. TGV-PSE Train (The TGV Company)
F. Intercity 125 Train (Great Britain)

FLORIDA HIGH SPEED RAIL SYSTEM

HANDOUTS

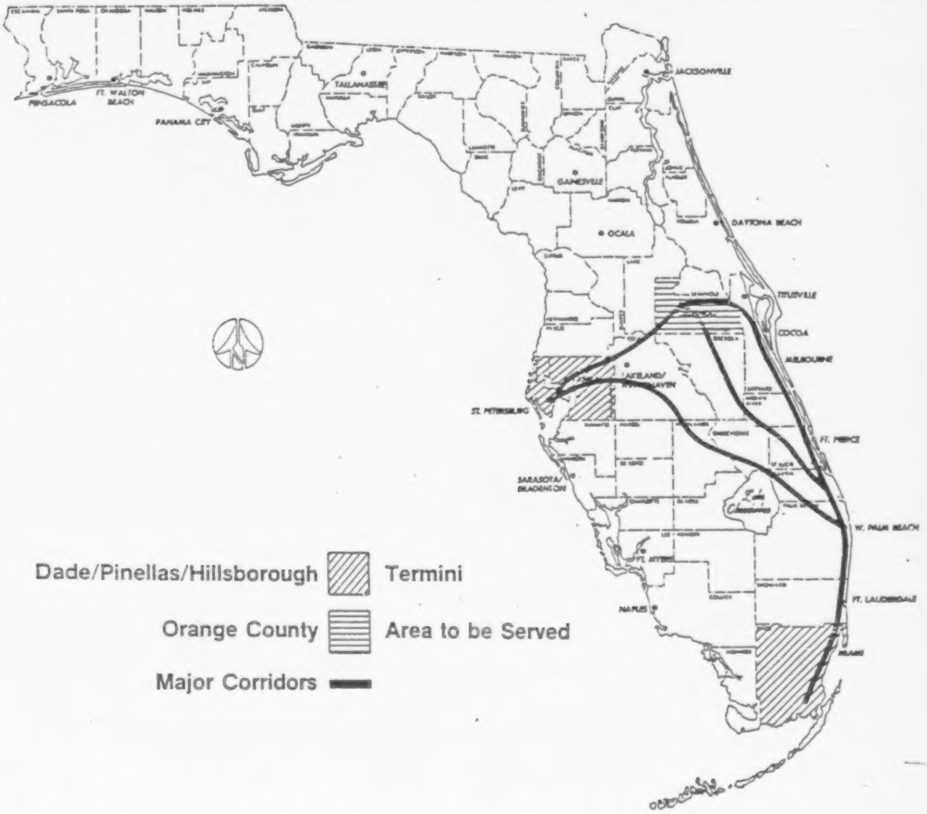
Florida High Speed Rail Transportation Commission

HIGH SPEED RAIL DEVELOPMENT SCHEDULE


RFP ISSUED
Dec. '86
INITIAL PROPOSALS SUBMITTED
Oct. '87
INITIAL CERTIFICATION REVIEW
INITIAL FRANCHISE REVIEW
Oct. '87
DETAILED PROPOSALS SUBMITTED
June '88
BEGIN SUFFICIENCY REVIEW
July '88
FRANCHISE AWARDED
Oct. '89
CONSTRUCTION COMMENCES
March '90
INITIAL OPERATIONS BEGIN
Jan. '95

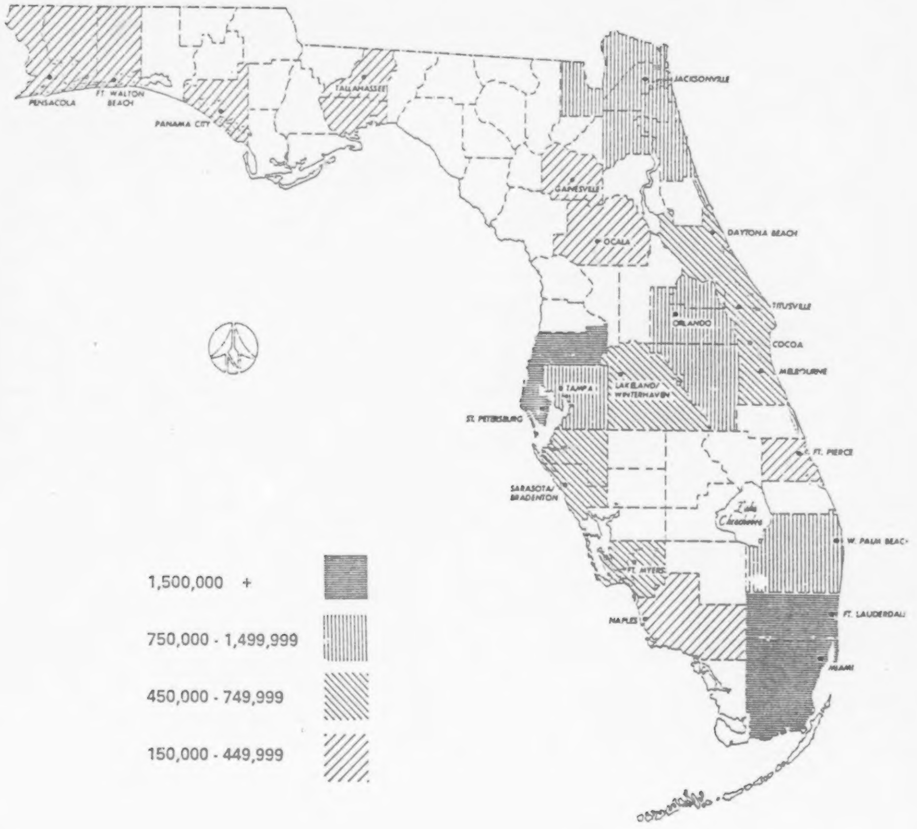
FLORIDA *HIGH SPEED RAIL* TRANSPORTATION COMMISSION

POTENTIAL *HIGH SPEED RAIL* CORRIDORS


JACKSONVILLE
TALLAHASSEE
PENSACOLA
FT. WALTON BEACH
PANAMA CITY
GAINESVILLE
OCALA
DAYTONA BEACH
TITUSVILLE
COCOA
MELBOURNE
LAKELAND/WINTER HAVEN
ST. PETERSBURG
SARASOTA/BRADENTON
FT. PIERCE
W. PALM BEACH
FT. LAUDERDALE
MIAMI
FT. MYERS
NAPLES
Dade/Pinellas/Hillsborough ▨ Termini
Orange County ☰ Area to be Served
Major Corridors ▬

FLORIDA *HIGH SPEED RAIL* TRANSPORTATION COMMISSION

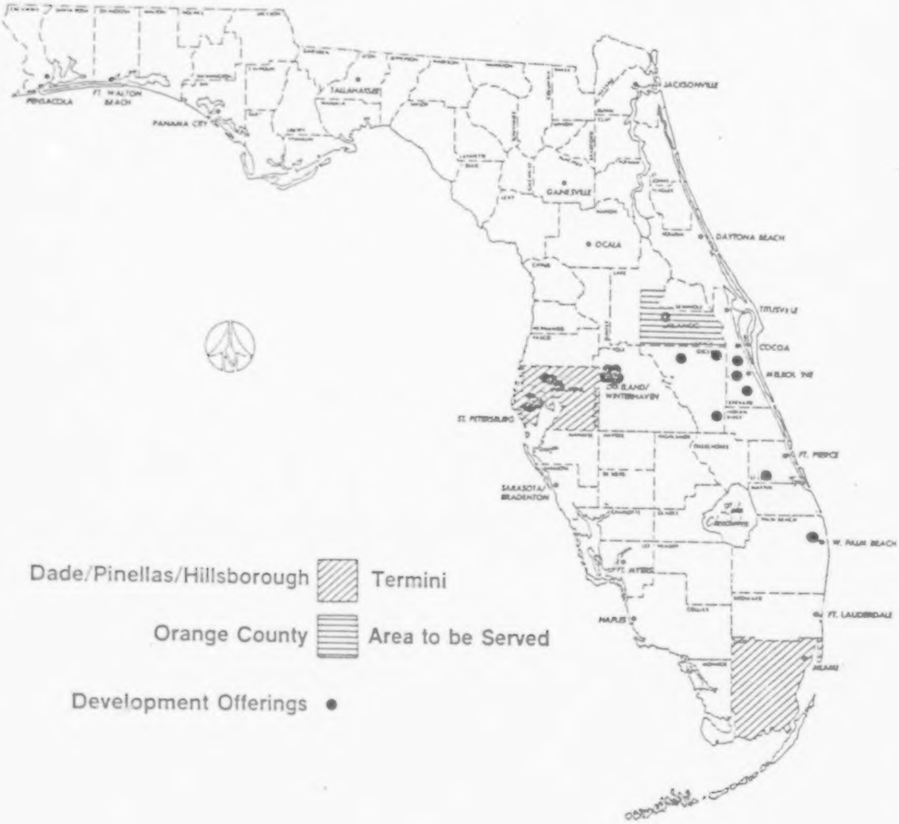
YEAR 2000 — POPULATION PROJECTIONS


PENSACOLA
FT. WALTON BEACH
PANAMA CITY
TALLAHASSEE
JACKSONVILLE
GAINESVILLE
OCALA
DAYTONA BEACH
TITUSVILLE
ORLANDO
COCOA
MELBOURNE
TAMPA
LAKELAND/ WINTERHAVEN
ST. PETERSBURG
FT. PIERCE
SARASOTA/ BRADENTON
Lake Okeechobee
W. PALM BEAC
FT. MYERS
NAPLES
FT. LAUDERDAL
MIAMI
1,500,000 +
750,000 - 1,499,999
450,000 - 749,999
150,000 - 449,999

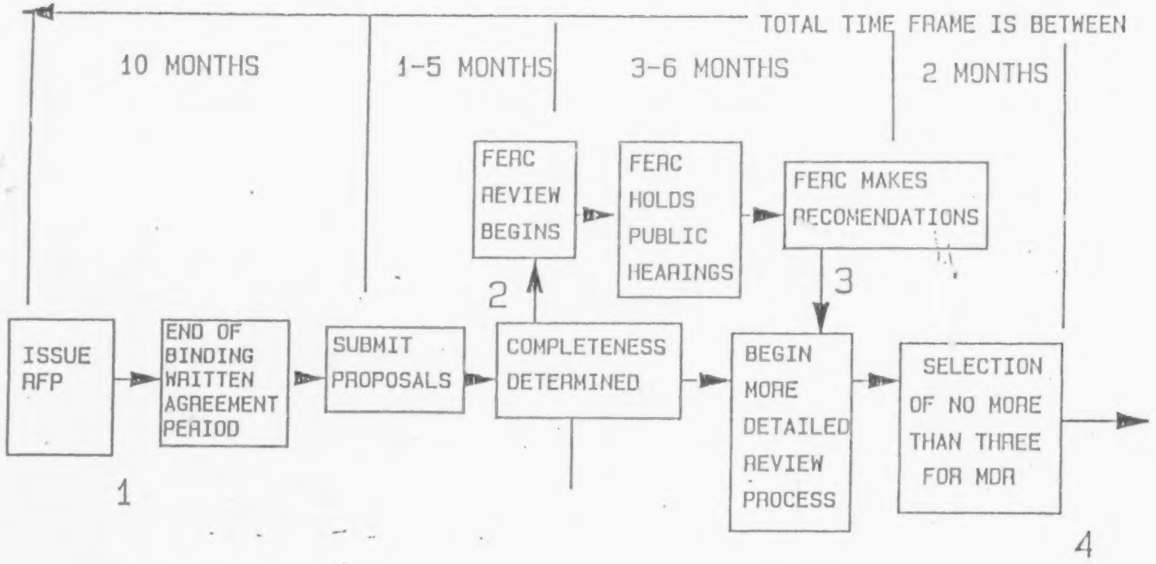
Source: University of Florida

FLORIDA *HIGH SPEED RAIL* TRANSPORTATION COMMISSION

PROPERTY DEVELOPMENT OFFERINGS

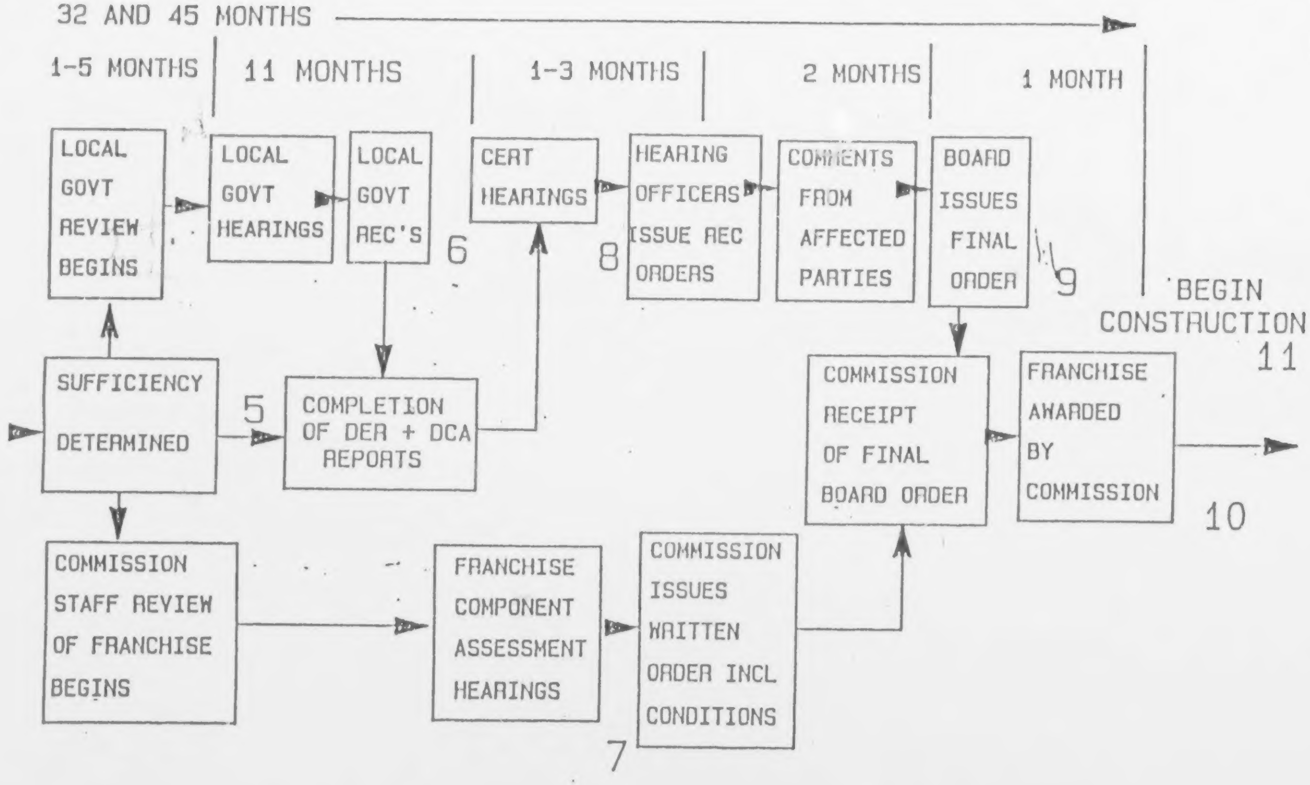

PENSACOLA
FT. WALTON BEACH
PANAMA CITY
TALLAHASSEE
JACKSONVILLE
GAINESVILLE
OCALA
DAYTONA BEACH
TITUSVILLE
ORLANDO
COCOA
MELBOURNE
LAKELAND/WINTERHAVEN
ST. PETERSBURG
SARASOTA/BRADENTON
FT. PIERCE
W. PALM BEACH
FT. MYERS
NAPLES
FT. LAUDERDALE
MIAMI
Dade/Pinellas/Hillsborough ▨ Termini
Orange County ▤ Area to be Served
Development Offerings ●

* FIGURE 1
FRANCHISE AWARD
OCTOBER,


TOTAL TIME FRAME IS BETWEEN
10 MONTHS
1-5 MONTHS
3-6 MONTHS
2 MONTHS
ISSUE RFP
END OF BINDING WRITTEN AGREEMENT PERIOD
SUBMIT PROPOSALS
COMPLETENESS DETERMINED
FERC REVIEW BEGINS
FERC HOLDS PUBLIC HEARINGS
FERC MAKES RECOMENDATIONS
BEGIN MORE DETAILED REVIEW PROCESS
SELECTION OF NO MORE THAN THREE FOR MDR
1
2
3
4

*NUMBERS CORRESPOND TO FIG 1 FRANCHISE ISSUANCE STEPS

LOGIC DIAGRAM
1986


32 AND 45 MONTHS
1-5 MONTHS
11 MONTHS
1-3 MONTHS
2 MONTHS
1 MONTH
LOCAL GOVT REVIEW BEGINS
LOCAL GOVT HEARINGS
LOCAL GOVT REC'S
6
CERT HEARINGS
8
HEARING OFFICERS ISSUE REC ORDERS
COMMENTS FROM AFFECTED PARTIES
BOARD ISSUES FINAL ORDER
9
BEGIN CONSTRUCTION
11
SUFFICIENCY DETERMINED
5
COMPLETION OF DER + DCA REPORTS
COMMISSION RECEIPT OF FINAL BOARD ORDER
FRANCHISE AWARDED BY COMMISSION
10
COMMISSION STAFF REVIEW OF FRANCHISE BEGINS
FRANCHISE COMPONENT ASSESSMENT HEARINGS
7
COMMISSION ISSUES WRITTEN ORDER INCL CONDITIONS